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ENGINEERING

Electrical World

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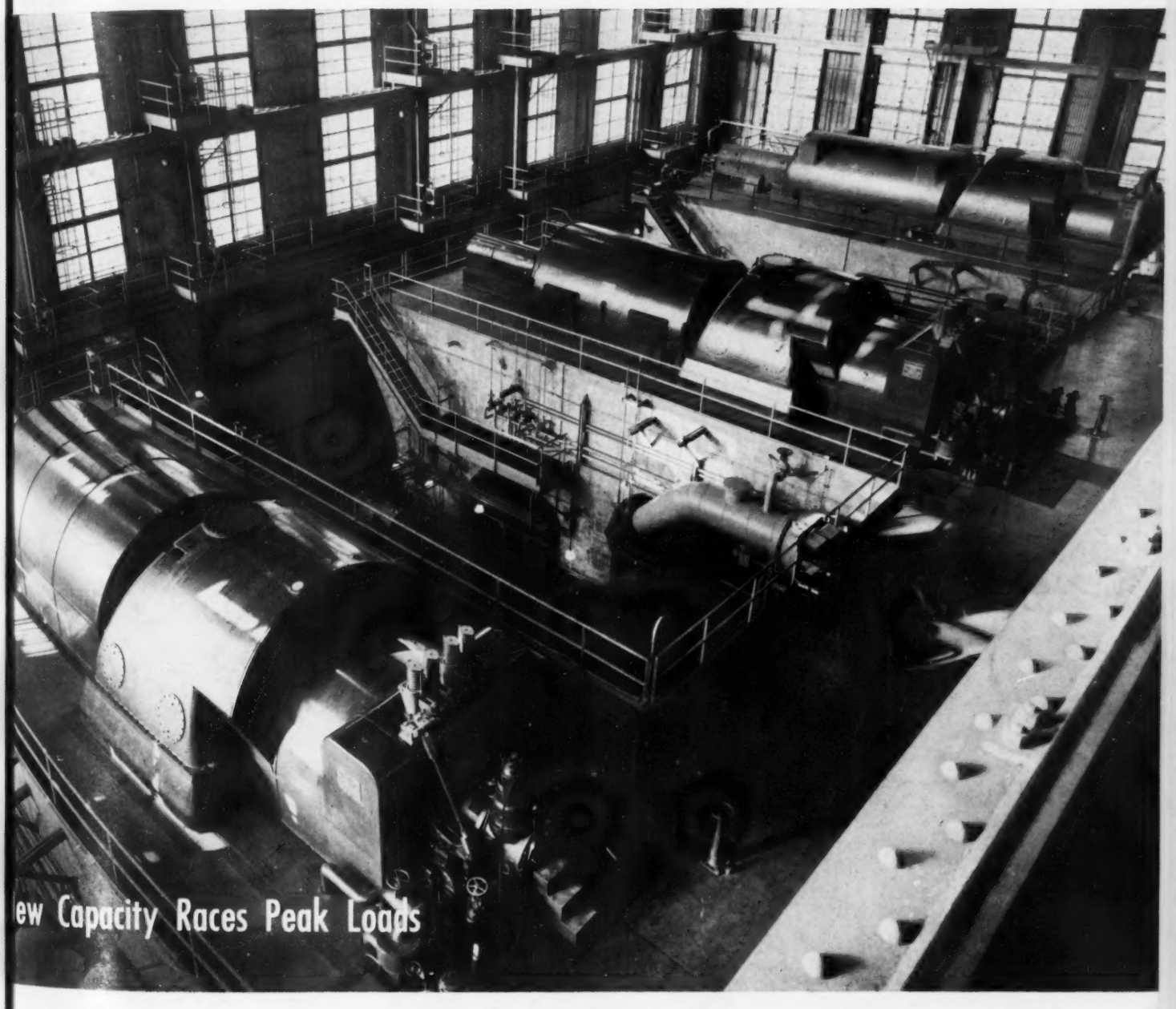


ew Capacity Races Peak Loads

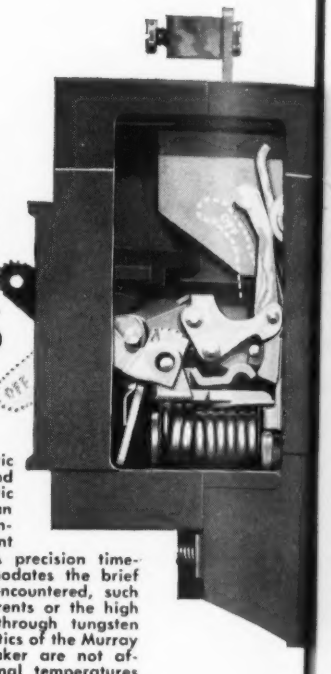
NOVEMBER 22, 1947

Features

NEWS OF THE WEEK
Unifying Underground Secondaries
Serving Urban Areas at Generator Voltage
Electric Utility Construction Varies Rhythmically

IN THESE MODERN ENCLOSURES—

Murray MAGNETIC CIRCUIT BREAKERS



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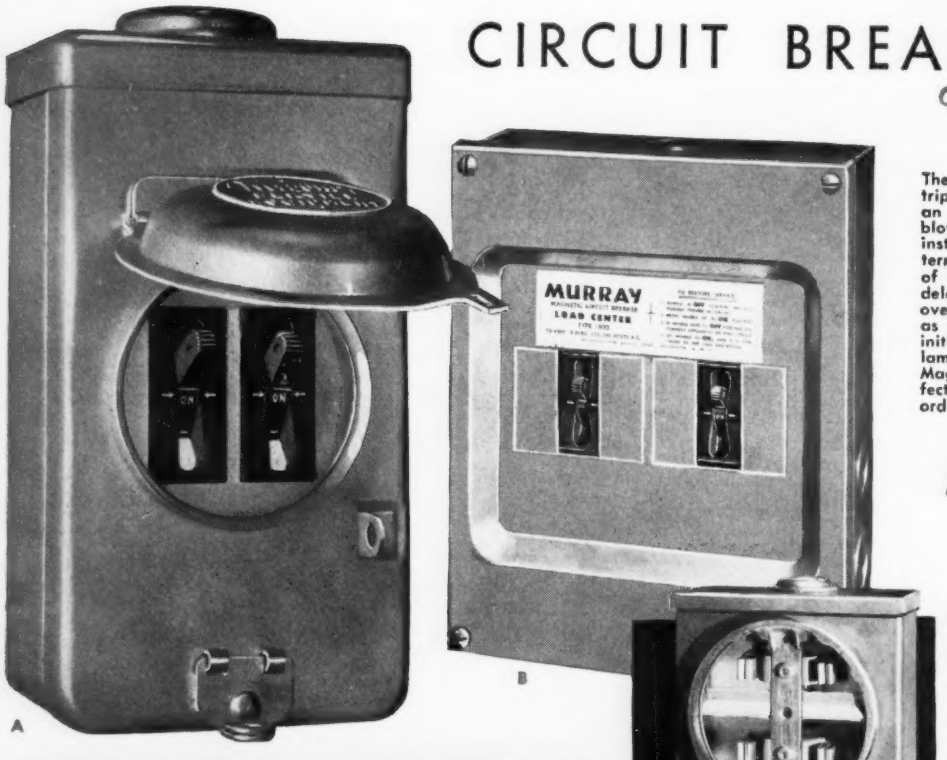

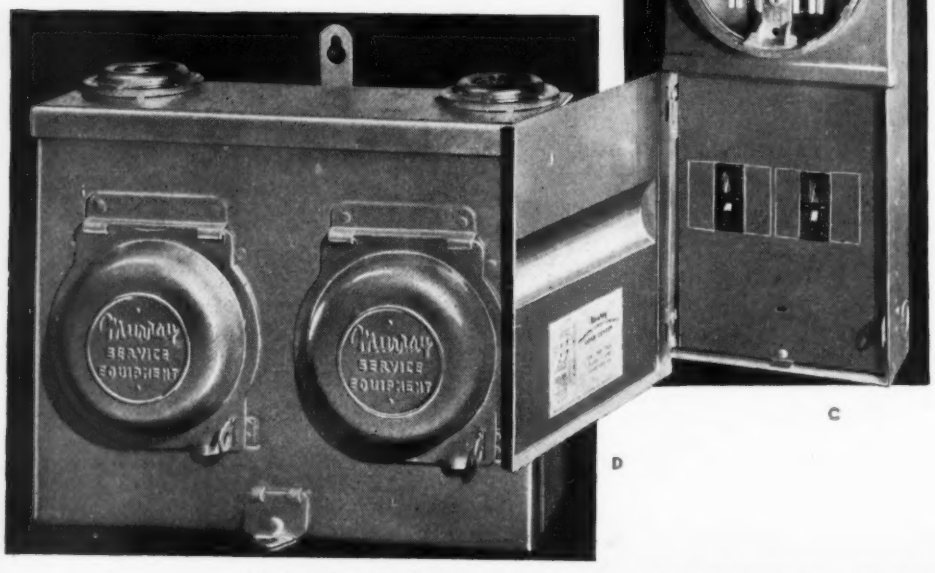

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November 22, 1947

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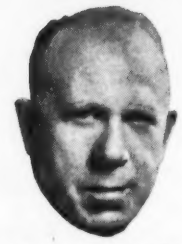

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Electrical World — Editorials

NOVEMBER 22, 1947

Notes on a Power Shortage

THERE'S BEEN considerable talk about a power shortage. A lot of it has concerned whether one exists in the U. S. today. No discussion we've seen has included a good, unassailable definition of what a power shortage is. Thus, all this talk hasn't been worth much, we think.

That's not to imply that ELECTRICAL WORLD has derived such a definition. Rather, its editors have come to a different conclusion. It seems self-evident that there are several possible definitions. Under some, this country certainly has a power shortage. Under others, it hasn't. "You reviews your politics," let us say, "and you takes your choice."

We can't imagine whatever in the world could be done with such a definition if we had it. Would the industry use it, say, to avoid blame for today's disparity between peak loads and installed capacity? How silly. Where is the blame that attaches to the industry because Hitler and Hirohito began the war which ultimately halted capacity installations? Where is the blame on the industry arising from the end of a world-wide war which left huge unsatisfied demand, which left national economies warped by unaccustomed controls, which left demand on a fabulously higher plateau, purchasing power leagues above it? These latter factors combine to strain capability of existing plant. The former limited the availability of plant. None of these factors may successfully be blamed on the power business other than in its own imagination. If they may, then the industry better quit fighting now and invest its money elsewhere. What future exists for any institution which can be condemned so groundlessly?

Apparently no one better realizes the absurdity of such condemnation than do those who could make the most of it—or be most likely to do so—were it true. Where is the federal attack on private power for a power shortage—assault such as that which flowed so freely in earlier years? Not in the Federal Power Commission. Not in Congress. The Interior Department is loaded with people who prefer public ownership on principle. But its firebrands are gone or silent. Indeed, their chieftain is the man who was so brilliantly right on the war power program cuts. To be sure, Bonneville cries shortage. It has, regularly, since its first turbine orders were shelved. But judging from testimony by private power leaders, Bonneville has a shortage. And to the extent that anyone is blamed for it, who bears the onus? Certainly it's not Bonneville.

We believe there's a lot of unthinking nonsense going on regarding the power situation. Nothing that could be done has been left undone. If such a situation must obtain, it is in the hands of as capable a crew of operating men as could be found. The war record and the service tradition of two generations prove that. Beyond that, what can be done? Who beyond a suicide despot and the deposed "god-king" can be blamed? Let's stop worrying about shortage, then, and work for the earliest coming of the day when the industry can be untroubled by any new load—including that which another war would bring. If we must worry about power shortage, there's one really to get concerned about.

★ ★ NEWS OF THE

New 23-Nation Trade Pacts Affect Electric Manufacturers

U. S. Reduces Tariffs on Power Equipment and Appliances —Other Nations Reciprocate—Import Duties on Essential Ores Lowered—First Agreements Become Effective Jan. 1

By William B. Whichard

WASHINGTON—Tariff concessions on imports of raw materials vital to the electric industry figure importantly in trade agreements concluded by the United States and 22 other nations. Details of the pacts were revealed this week (Nov 18) by the United Nations.

The U. S. also agreed to reduce its tariffs on many types of power equipment and electric appliances. But these concessions, in view of the present competitive position of foreign electrical equipment makers, were overshadowed by widespread reductions of duties and other trade restrictions on similar products by the other signatory nations.

The tariff pacts, affecting some two-thirds of the pre-war trade of the 23 countries, will be placed into effect provisionally by the U. S., Australia, the Belgium-Netherlands-Luxenburg Customs Union (Benelux), Canada, France, and the United Kingdom next January 1. Other nations will put them in force as they obtain necessary domestic ratification, with the deadline for formal acceptance by all set for June 30, 1948.

The agreements are to extend for 30 months, subject to withdrawal by any participating country upon six months' notice thereafter. But any nation may withdraw or modify its concessions if they increase imports so sharply as to threaten domestic producers.

Probably the most significant U. S. concession, in the eyes of the electric industry, was the reduction of the duty on Bauxite, raw source of aluminum, from $1 to 50 cents per ton. The 4-cent import excise on copper, suspended by Congress last year until March 31, 1949, was cut to 2 cents per pound.

Duties on other import metals were cut as follows:

Zinc ores and concentrates, from 1.2 to 0.75 cents per pound of zinc content; slab zinc, from 1.4 to 7/8 cents per pound; crude aluminum, from 3 to 2 cents per pound; tungsten ore and concentrates, from 50 to 38 cents per pound of metal content; ore containing 35 percent or more metallic manganese, from 1/2 to 1/4 cent per pound of metal content.

Pig iron containing more than .04 percent phosphorus, from $1.125 to 75 cents per long ton. Lesser reductions also were granted for steel ingots and finished and semi-finished steel products ranging from a fraction of a cent for low-grade steel to 5 percent of existing ad valorem rates for high-priced, high-alloy steels.

Of less immediate significance, but posing possible future problems for American industry, were cuts in U. S. import duties on electrical equipment. The UN report noted that the 25 percent rate applied to "a large part of all electrical goods" had been reduced to 15 percent. Specific reductions listed included the following:

Telephone, diagnostic and therapeutic apparatus — except X-ray — switchgear, fans and blowers, from 35 to 17.5 percent. Washing machines and telegraph equipment bound—"frozen" —at 17.5 percent. X-ray apparatus and electric ranges, from 17.5 to 10 percent.

Foreign concessions for electrical equipment exports of the U. S. included reductions of duties and other restrictions by most nations on refrigerators and refrigeration installations. Most countries also lowered trade barriers against electric ranges and other household appliances. Reductions for power-driven machine tools also were general.

The UN report showed that foreign countries granted concessions on electric equipment as follows:

Benelux froze present low duties on dynamos and transformers. Brazil cut duties on transformers, reductions ranging from about 40 percent on smaller transformers to one-third on heavy types. Ceylon lowered duties on transformers and electric motors from 20 to 15 percent. Chile froze present low duties on turbines, transformers over 200 kva, and meters.

China cut duties 25 percent on steam

WORKMEN connect the power plant of the *U.S.S. Maloy*, at left, with a substation of the Central Maine Power Co system at Portland. Another destroyer escort, the *Foss*, will be tied in at a neighboring pier. Total addition, 7,200 kw

FLANKED on his right by Homer H. Chapman, Elmira Division manager, and by Albert F. Tegen, president of the General Public Utilities Corp, Ralph D. Jennison, president of the New York State Electric & Gas Corp, addresses a luncheon for honor guests at the Hickling Station cornerstone laying at East Corning.

LAYING THE CORNERSTONE for the 35,000-kw Hickling Station of New York State Electric & Gas Corp is Lt. Gov. J. R. Hanley of New York.

and hydraulic turbines, lowered rates from 15 to 12½ percent on dynamos and low capacity transformers, and continued present low tariffs on heavy generating and transmission equipment. France made unspecified reductions in duties on electric motors and industrial transformers. New Zealand cut duties over 50 percent on insulators and hydro turbines, lowered from 30.625 to 20 percent the duty on generating equipment. United Kingdom reduced rate on stationary internal combustion engines from 20 to 17½ percent.

New Labor Source

Between 1,500 and 2,000 men are being selected from European displaced persons' camps to work on six power plants which are to be built by the Ontario Hydro-Electric Power Commission. Osborne Mitchell, Commission secretary, said, "We are short of men on the various projects and in addition there is a big turnover." The first groups are expected to arrive by the end of the year.

Power Policy under Study by Congressional Group

The House Appropriations Committee has its special staff of technical advisors busy on the development of a new national power policy. The staff, composed of consulting engineers, accountants, and other technicians, is expected to come up with a report within six weeks.

Study of the government's position on all phases of the electric power industry was instituted at the request of Rep. Ben Jensen, Iowa Republican, who is chairman of the subcommittee on Interior Department appropriations. The staff recommendations will be submitted to the full appropriations body for discussion with "the proper legislative committees"—on public works and public lands.

The committee staff already has consulted with power specialists of the Interior Department, Federal Power Commission, and other federal agencies. Its representatives also have contacted utility industry groups, engineering firms, and other independent interests.

Scope of the study extends from a review of the activities of FPC and all phases of federal hydroelectric development to simplification of Congressional procedure in handling appropriations and legislation dealing with federal power projects. The group also is considering possible modifications of most existing power legislation, including the Federal Power Act, laws dealing with Bonneville Power Administration, the Boulder Canyon project, TVA and Southwestern Power Administration, and the Rural Electrification Act.

Jensen said that the objective of the investigation was to clear up, once and for all, much of the considerable controversy which exists over the federal government's power operations. He points out that his subcommittee and members of both the public works and public lands committees had made extensive tours of federal power projects since Congress recessed last summer.

"We feel that we are much better informed on these activities now," he said. "And we hope that, in cooperation with the legislative committees, we can work out a final settlement on a sound power policy."

•

30-Year Franchise Voted

Daytona Beach voted 5,090 to 927 in favor of granting Florida Power & Light Co a 30-year franchise.

Carrier Developments Reported to PEA Group

Inexpensive Form for Relaying of Less than 44-Kv Lines now Available — Facsimile Discussed

Efforts to induce manufacturers to create a comparatively inexpensive form of carrier for relaying of lines of less than 44 kv have borne fruit. This was reported to the Communications Committee of the Pennsylvania Electric Association in Baltimore on Nov. 13 and 14. One occasion for the meeting there was to afford opportunity to visit the telecommunication laboratory of the Federal Communications Commission at Laurel, Md., where interference is monitored and apparatus approved for use by licensees. Developments in facsimile apparatus and high-voltage carrier were other features of the sessions.

Unmodulated fixed tuning was cited by J. G. McKinley, West Penn Power Co, as the simplification achieved in the Link carrier unit comprising both transmitter and receiver. Frequency change is effected by change of crystals. Operation may be either continuous or initiated. Attenuation rating is 50 db., and draft on station battery is 25 w. West Penn, he said, is giving a tryout to one of the pilot-production units. Similar tryout is being given to a General Electric DCS-20 assembly comprising three separate units (transmitter, amplifier, and receiver). Selectivity was stated to be 20 db at 0.4 percent of frequency and sensitivity ½ millivolt.

Facsimile Apparatus Described

Characteristics of recent types of facsimile apparatus appropriate for electric utility intelligence application were presented by H. J. Smith, Duquesne Light Co. He mentioned page width of 8.2 in., speeds of 3.4 in. per minute (for radio, half that on telephone channels) and 100-line definition. Receiving operation can be on rolls 200 ft long, but transmission is one sheet at a time. Supplementary communication between stations is necessary. The service was viewed as competitive with teletypewriter, but equipment is not likely to be available for another year, Smith said.

In explaining the functions of the FCC laboratory, E. W. Chapin, chief of the division, said a primary objective was to restrict certification of equipment to that which would contribute to narrowest feasible band-width and therefore to as large as possible a total number of channels. He believes directive antennas, particularly for microwaves, would afford additional channels and that designs for minimized lobes in unwanted directions would do the same. He said that in general not nearly enough emphasis is placed on receiver selectivity.

Efficacy of the voice-transfer and automatic gain features of a new double-frequency duplex carrier system led to its adoption on the West Penn-Monongahela system, said J. G. McKinley. In discussion of J. D. Booth's description of this Westinghouse JY system, he said that conditions on utility interconnections were increasingly demanding that carrier move out of the point-to-point philosophy and become capable of working on common battery supply and overcoming the attenuation of PBX and other extensions. The new equipment is admittedly complex but these specifications make it so; designed life of components is 25 years, said Booth. The equipment provides full electronic transfer of talk-direction with unit dropping out virtually after each syllable. A Brush recording of single-side band conversations on the Portland (Ore.) installation was demonstrated along with the West Penn unit.

THIS 300-ton transformer for the Genissiat hydroelectric project in southeast France was too big to pass through a tunnel in Mont du Chat in the French Alps. However, embarrassed engineers did not discover this until the transformer stuck 500 yd from the exit. Acetylene torches were used to burn away the steel lining of the tunnel and free the transformer. Specially built 96-wheel, 180-ft trucks were used for the trip from the factory at Grenoble to the damsite. Genissiat will begin operation in December with 70,000-kw capacity

•

TVA Plant Unit Breaks

A turbine shaft on one of the two main generators at the Bowling Green steam generating plant of the Tennessee Valley Authority broke recently. Damage was estimated at over $40,000.

2 Hydro Plants Planned for Michigan Peninsula

Two hydroelectric generating plants in the peninsula section of Michigan—the first at Big Quinnesec Falls on the Menominee River, south of Iron Mountain, and the second at Michigamme storage reservoir, north of Iron Mountain—will be built within the next two years by the Wisconsin Michigan Power Co.

G. W. Van Derzee, president of the company, stated that the main objective of the two projects is not only to supply additional kilowatt capacity but to offset, in part, the rising cost of coal by generating the maximum possible from hydro.

The Big Quinnesec Falls project calls for the construction of a new dam and power plant and will include two 8,000-kw generators. The Michigamme project will include the installation of a hydro machine at a damsite built in 1940. This dam was constructed at that time to impound water which otherwise would be wasted in flood periods. An 1,800-kw generator will be installed.

Completion of the two projects in about two years and of two others now under way in the expansion of the Port Washington plant will bring the company's combined generating capacity to 822,705 kw.

Wisconsin Judge Pondering Over Rate Making 'Freedom'

Commonwealth Telephone Co and Public Service Commission Present Briefs in Case Arising out of Order Reducing Rates in Two Rivers—New Theory of Fixing Utility Rates Involved

(ELECTRICAL WORLD Staff Report)

MADISON—Wisconsin's Dane County Circuit Court has under advisement this week (Nov 19) the question of whether the Wisconsin Public Service Commission's "new freedom" in utility rate making is legal.

In a brief submitted last week at a short hearing, the Commonwealth Telephone Co argued at length that the PSC was far removed from proper procedure when it issued a rate order cutting charges for service in Two Rivers by about $10,000 yearly.

At considerably less length, but with fervor, the PSC's brief insisted that nothing of the kind was true. In essence, Commonwealth beseeched the court for a return to orthodoxy in rate making. The PSC, to the contrary, took the court to the hilltop and showed it what a wonderful world rate-making could be under the new freedom.

Points on which Commonwealth attacked the PSC's Two Rivers order, which set rates without valuing the property, finding a rate base or a rate of return, were:

1. PSC failed to make the findings of fact required by state law.
2. Its new Two Rivers rates were reached and issued on unlawful procedure.
3. The rates are unsupported by substantial evidence of record.
4. The order is arbitrary and capricious.
5. Commonwealth is deprived of property without due process of law and without just compensation.

PSC's brief held that:

1. The order fulfills procedural due process.
2. PSC findings are supported by substantial evidence.
3. "The order is not invalid because it fails to afford just compensation."
4. The order is neither arbitrary nor capricious.
5. The order is not unreasonable.

Strangely enough, Commonwealth's brief conceded a point which had been considered extremely unorthodox when it appeared in the PSC's order. That was that utility rate making "is and has been an exercise of the power of police."

PSC, in its order, asserted that it was deserting the traditional concept—that rate making is an exercise of the eminent domain—for the more logical concept that rate making is a use of the police power. But Commonwealth's brief made the point that police power or any other power notwithstanding, even the legislature could not enact laws which would deprive people of property without just compensation. This, it said, is the effect of the Two Rivers order because it sets rates unreasonably low.

Commonwealth also made great point of the fact that the PSC order is too vague to permit adequate review, since it establishes no findings of fact as to valuation of the Two Rivers property, rate base or rate of return.

COMPLETING a three-month program of capacitor installations, totaling 11,000 kva, a line crew of the Electric Power Board of Chattanooga installs a 180-kva capacitor bank on a 12,000-v feeder

Throughout its brief, PSC argued that Commonwealth was extremely "vague" as to what findings of fact it wanted. It saw this repeated demand for specific findings as an attempt by Commonwealth to find some specific flaw upon which it could have the entire rate order reversed. PSC contended further that the state law only required it to find whether rates are or are not just and reasonable. It noted that the state law requires "findings of fact (which) shall consist of a concise and separate statement of the ultimate conclusions upon each contested issue of fact without recital of evidence." Very well, PSC's brief argued, we have found that the rates in Two Rivers were unreasonable, and we don't have to recite evidence.

Another point of the PSC brief was that all the evidence is available for the court if it chooses to follow orthodox rate-making procedures and set up a rate base and a rate of return of its own. It argued, however, that this process, however traditional, is too imprecise and valueless for the PSC, and added:

"We see no point in the court or anyone else going through that sort of mental legerdemain . . . the evidence in the case is before the court. The court cannot decide this case, so far as the merits of the order are concerned, without reading that evidence."

Importance of the case lies in the precedent it sets. Having refused to follow tradition and choose among formulas for a way of setting a rate base and determining a rate of return, PSC chose a simpler method of setting Two Rivers rates. It estimated future business, estimated the point in the rates at which revenues would be cut rather than increased, and figured—one way or another—what it thought is a fair profit. On these three bases, it rested its decision. If this becomes the accepted method of rate making, utility men in Wisconsin fear, PSC will have too much discretion and management have too little specific basis on which to appeal rate orders it opposes.

•

Boston Edison Supported

The Massachusetts Public Utilities Commission has denied a petition of A. W. Perry, Inc, Boston realtors, to compel the Boston Edison Co to furnish it with electricity for resale to tenants of its properties and others. Boston Edison had refused to continue an agreement of many years with the realty company because the utility can increase its earnings by selling direct to the consumers.

Oklahoma Ordnance Plant Sale Starts Controversy

Grand River Dam Authority and Public Service Co of Oklahoma Both Want 20,000-Kw Installation

Congress, the Federal Works Administration, and Oklahoma politics have become involved in the battle for a 20,000-kw, war-surplus steam generating plant. Upshot is that War Assets Administration, which was about to dispose of the plant a few weeks ago, has held up the sale "pending further study."

The plant was built by the government to serve the Oklahoma Ordnance Works at Pryor, Okla. When WAA offered the property for sale, Oklahoma's Grand River Dam Authority submitted the highest bid, $3,500,000.

Public Service Co. of Oklahoma reportedly offered approximately $1,000,000 less. GRDA also claimed priority in the bidding under provisions of the Surplus Property Act giving preference to state bodies.

A few weeks ago, when a WAA review board considered the bids, three members of Oklahoma's Congressional delegation intervened, charging that GRDA lacked legal authority to purchase the plant. Sen. Edward H. Moore, Republican, headed the group, which also included Reps. George Schwabe, Republican, and Glen Johnson, Democrat. Meanwhile, former Oklahoma Governor Kerr, state Democratic committeeman, asked President Truman to aid GRDA. He claimed that "Republican Congressmen" were delaying sale to the agency.

Now Rep. Ross Risley has indicated that his subcommittee of the House Executive Expenditures Committee will investigate the entire matter.

Officials of Public Service Co. are planning another bid, based on a plan to install an additional 60,000 kw of capacity to utilize the full capacity of the plant's six 170,000-lb-per-hour steam boilers. The company would install a 30,000-kw turbo-generator now on order as the first step.

Utility spokesmen said they had been unable to learn from WAA if such expansion of the plant would be allowed under the terms of sale. The property will be sold subject to federal recapture in event of a national emergency. Therefore, company men added, they felt they were forced to bid in the dark.

Senator Moore asserted that under the state statute creating GRDA, the agency had no authority to operate a steam generating plant or issue bonds for the purchase.

Federal Works Agency, which holds GRDA bonds in the principal amount of $14,000,000, reported it favored purchase of the plant by the state agency. FWA engineers' studies held that operation of the plant to provide steam standby for Pensacola dam's hydro output would increase GRDA's firm capacity.

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Armistice Day Holiday Blessing to Union Electric

Armistice Day was the most popular of all the year's holidays for power-short Union Electric Co of Missouri. On Nov 10, a 40,000-kw turbine at its Venice, Ill., plant was put out of service by a boiler tube blowout. The holiday gave the utility a chance to get the unit back in service by Nov 12, without seriously inconveniencing customers.

When the accident happened, an immediate appeal was made to over 100 large industrial users in the St. Louis area to reduce their consumption of electricity. All cooperated and some closed down immediately. Other power sources were able to make up 15,000 kw of the shortage.

Under normal conditions loss of the Venice unit would have caused no difficulty. However, none of the company's hydro plants has been operating at full capacity because of the water shortage.

E. F. Scattergood, APPA Head, Dies in Los Angeles

Ezra F. Scattergood, 76, president of the American Public Power Association, died of heart disease, Nov 15, at Los Angeles. He had been serving the Los Angeles Bureau of Power & Light in an advisory capacity since his retirement in 1940 as chief electrical engineer and general manager.

Scattergood, who headed the Bureau from its organization in 1909, had a world-wide reputation as an authority on electric power generation, transmission, and distribution. He not only supervised construction of the many projects of the Los Angeles system but saw the system grow until it was not only the largest municipal system in the United States but also the eighth largest electric utility in the nation, serving over 600,000 customers.

E. F. SCATTERGOOD

Throughout his life he was an advocate of public power ownership and frequently was called to serve or advise the government on power problems. In 1925, he directed the economic study of the Southwest which was used to prove to Congress that there was a market for power and water from the Boulder Canyon project and that the project was financially sound. He was the first national chairman of the old National Municipal Utilities Association.

Though educated as a mechanical engineer, he became an outstanding electrical engineer, writing and lecturing on many topics in the power field. He became a fellow of the American Institute of Electrical Engineers in 1913.

Born in Burlington County, N. J., he was educated at Rutgers and Cornell Universities. After teaching at Rutgers and the Georgia School of Technology,

Operator Energized at 132 Kv

In testing the 132-kv gas-compression cable at the expanded Hams Hall power station (see center spread, ELECTRICAL WORLD, September 20) the test engineer and his inverted Schering bridge were inclosed in a Faraday cage insulated from the earth. The operator and the instruments were thus charged with the cable, to the full test voltage. This unique measure was taken, *The Electrician* says, to assure protection from outside electrical interference and to exclude stray capacity losses. Ordinary measurements on a buried cable involve vectorial corrections for dielectric losses in leads and in the test transformer. Inversion of the bridge averts these corrections. Placing the operator within the cage obviated corrections for the stray losses that would be introduced by use of long insulating handles for manipulation of the instruments.

he went to Los Angeles in 1902 as an engineer for the Huntington Light, Power & Electric RR Co. Four years later he started his own consulting practice, which he gave up in 1909 to head the Los Angeles municipal system.

•

UWU Sends Own Agent to Run West Coast Region

The Utility Workers Union of America, CIO, has sent its own representative to look after its interests on the West Coast after removing James Daugherty as regional director and Executive Board member for refusing to sign a non-Communist affidavit.

Clem Lewis, national representative in Ohio, has been assigned to the West Coast by President Joseph A. Fisher. Lewis originally was a member of UWU's "subway" local in New York.

Fisher removed Daugherty from the UWU payroll and as regional director effective Nov 15. The Executive Board voted him off the Board itself following a trial Oct 28.

Fisher plans to appoint a West Coast member as new regional director.

The annual convention in Buffalo last month went on record in favor of bringing wage rates and working conditions in municipally owned utilities up to the standards prevailing among privately owned utilities. The UWU newspaper erroneously reported this action as an endorsement of publicly owned utilities. This is being corrected, according to Pachler, who said the union favors private rather than public ownership.

•

Energy Output in August Sets New High Record

Production of energy by electric utilities during August totaled 21,743,754,000 kwhr, the Federal Power Commission reports. This is the highest monthly production of record and exceeds by 0.5 percent the previous record set in January, 1947.

The August production is 7.2 percent above the January, 1945, total, which was the war-time monthly maximum and is 11.4 percent higher than August of last year. It is also an increase of 4.6 percent over July, 1947, production.

Combined utility and industrial production was 25,968,835,000 kwhr during August, an increase of 9.7 percent compared with August, 1946.

Production of electric energy by water power in August, 1947, amounted to 6,053,377,000 kwhr. or 27.8 percent of the utility total, in comparison with 31.4 percent in August of last year.

ADVERTISEMENT which won for the Consolidated Edison Co of New York an award from the *Financial World* for the best public utility advertisement in 1946 based on an annual report is shown to Clarence L. Law, vice-president in charge of public relations, by Henry Obermeyer, assistant vice-president. Others, left to right, are Raymond M. Martin, advertising department manager; Donald S. Jones, design bureau manager; and Paul Binner, production bureau manager. Seated is Helen M. Rockey, manager of the advertising department's copy bureau

Pennsylvania Anti-Strike Law Tests Coming Soon

HARRISBURG—First tests of Pennsylvania's new law banning strikes and lockouts in public utilities are expected soon. The tests are expected to involve the Utility Workers Union, CIO, and the Luzerne County Gas & Electric Corp, Wilkes-Barre, and the same union and the Scranton Electric Co.

Before the tests can be made, the recently appointed labor-management committee (EW, Nov 8, Page 88) must recommend a panel of arbitrators from which the governor will select twelve.

The union had a strike-intention notice filed last spring. When collective bargaining broke down in August, the union and utilities agreed to settle the dispute by letting the new law "take its course." State mediators have continued to seek settlements, however.

A third dispute was shaping up as the result of the request of the Independent Association of Employees of the Duquesne Light Co to reopen wage negotiations (EW, Nov 1, Page 13). The union's strike last year, which seriously harrassed Pittsburgh, was the chief reason for passage of the anti-strike law.

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Gets 25-Year Franchise

After agreeing to a payment of $16,000 to the city, the Mississippi Power & Light Co was granted a 25-year franchise by the Board of Aldermen of Vicksburg.

•

Wickard Warns Co-ops They Face Profits Tax

Claude R. Wickard, REA administrator, warned that REA cooperatives now face a threat of a profits tax in a talk last week before 400 representatives of such cooperatives in New Mexico, Texas, and Arizona at a tri-state meeting in Albuquerque, N. M.

Wickard said the House Ways and Means Committee is conducting an investigation which might end in a recommendation for a profits tax on the cooperatives' earnings. He said such a tax would be unfair, declaring the organizations are non-profit and already pay full taxes on all branches of their operations.

At present, all surplus at the end of each year is returned to the members in the form of a dividend, and automatically becomes taxable as income, Wickard stated. Any additional tax would, in his opinion, come under the head of double taxation.

Wickard declared REA cooperatives throughout the country have made connection to some 240,000 new rural customers this year and predicted an even larger number in 1948.

TVA's Use of Funds Gets Support of Congressmen

A House-Senate dispute over apportionment of appropriations for the Tennessee Valley Authority flared briefly, then sputtered out this week.

A House subcommittee met almost as soon as Congress convened. Its purpose was to probe charges by Sen. Homer Ferguson, Michigan Republican, that TVA proposed to make "improper use" of some $2,750,000 of funds appropriated last summer. The House body concluded that TVA's apportionment of the disputed funds was in full compliance with instructions of Congressional appropriations committees.

The incident arose when Senator Ferguson learned that TVA was planning to reallocate approximately $1,000,000 of new funds originally scheduled for dam construction and $1,750,000 set for chemical plant construction. These sums were to be used instead for resource development and other purposes.

House members in charge of TVA appropriations pointed out that there were no restrictions on new funds in the money bill. The only limitations imposed by Congress were contained in the House-Senate Conference report which set ceilings on the amounts of new appropriations to be devoted to dam and chemical plant construction.

The reallocation was made necessary, one House member explained, when TVA found that its unobligated balance of funds previously appropriated came to more than an estimated $12,000,000. Since the additional old funds were earmarked for plant construction, a portion of the new appropriations had to be reallocated to stay within the ceilings on construction set by the conference report.

Senator Ferguson and House committeemen were scheduled to confer later this week. The House members expressed confidence that the dispute could be "straightened out."

Meanwhile, TVA sources reported that no use of the disputed funds would be made pending final settlement of the matter.

•

Utility Bonuses Few

Payment of non-production bonuses is less prevalent among electric light and power companies than it is in other industries. Of 255 light and power companies surveyed by the Bureau of Labor Statistics, one-fourth granted bonuses last year unrelated to production, such as attendance, Christmas, profit-sharing, and cost-of-living bonuses. The proportion was the same in regard to both plant and office workers. The average for manufacturing plants was 40 percent for plant workers and 45 percent for office workers.

•

UWU Trying to Organize Unit at Duquesne Light Co

The Utility Workers Union of America, CIO, will seek bargaining recognition from the Duquesne Light Co after a majority of the employees sign membership cards in a drive now under way at the Pittsburgh utility, it was learned in Washington this week from William J. Pachler, UWU secretary-treasurer.

The CIO membership drive is being assisted by George L. Mueller, president of the Independent Association of Employees of the Duquesne Light and Affiliated Companies, which now represents Duquesne employees, and of the United Utility Unions of America, a federation of independents recently dissolved.

At a meeting in Pittsburgh, Mueller and his associates are reported to have promised CIO President Philip Murray and UWU President Joseph A. Fisher that they would assist in trying to bring the nine or more unions affiliated with the Triple U, as well as the Duquesne employees, into the CIO. Washington sources say Mueller has not been promised any job with UWU but will have to rely on what deal he can make with the prospective Duquesne local.

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The Voters Said No

Citizens of Henderson, Ky., at a recent election defeated a $2,100,000 bond issue intended to finance a new municipal power plant.

MEETINGS

Interstate Power Club of New York—Meeting, Hotel Martinique, New York, December 15. Thomas C. Roe, secretary, Delaware Power & Light Co, Salisbury, Md.

Previously Listed

American Society of Mechanical Engineers—Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, December 1-5.

Pennsylvania Electric Association—Meter Committee, Benjamin Franklin Hotel, Philadelphia, December 11-12.

Canadian Electrical Association—Winter Conference, Chateau Frontenac, Quebec, January 12-18.

American Institute of Electrical Engineers—Winter General Meeting, William Penn Hotel, Pittsburgh, January 26-30.

SEC RULINGS

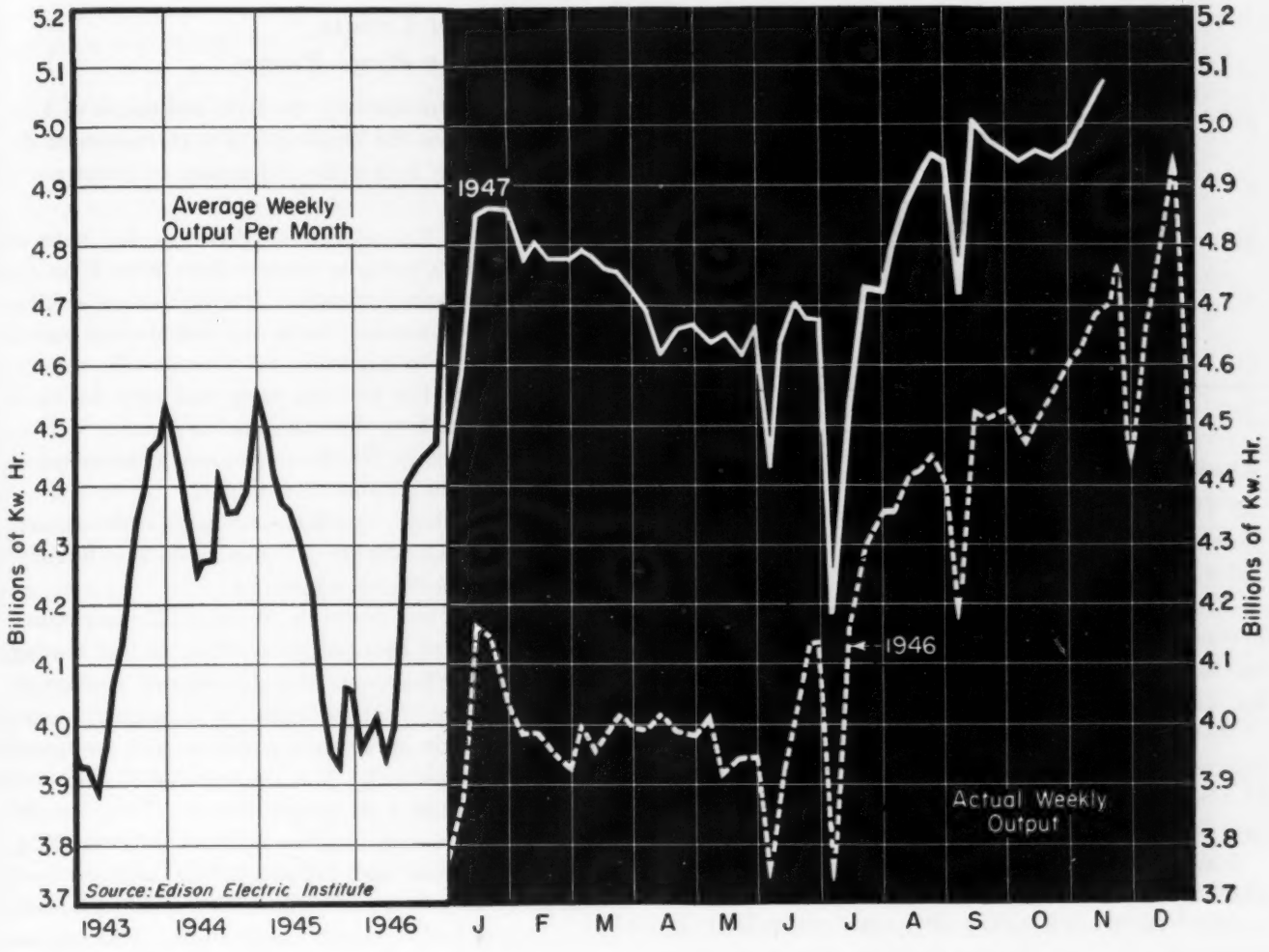
New England Electric System subsidiaries have received permission to borrow a total of $3,300,000 from banks to finance construction through next June. The notes, which will mature within one year after issuance, will bear interest of not more than 1¾ percent per annum. The subsidiaries and the amounts are: Malden Electric, $250,000; Suburban Gas & Electric, $400,000; Lawrence Gas & Electric, $750,000; Eastern Massachusetts Electric, $625,000; Haverhill Electric, $500,000; Gloucester Electric, $250,000; Beverly Gas & Electric, $275,000, and Salem Electric Lighting, $250,000. (Release No. 7787).

Indiana Service Corp's proposal to borrow $10,000,000 before next February 2 from three banks on promissory notes, maturing on December 31, 1950, and bearing interest of 1¾ percent per annum, has been approved. The bank loans with $1,900,000 from the general funds of Indiana, a subsidiary of American Gas & Electric Co, will be used to redeem the corporation's outstanding $6,656,500 of first and refunding mortgage of 5 percent gold bonds, series A, due 1950, and $4,925,900 of first lien and refunding mortgage 5 percent gold bonds, series A, due 1963. The former will be redeemed at 102½ percent and the latter at 103 percent, plus accrued interest. The refinancing of the mortgage bonds is a temporary expedient prior to the merger of Indiana into Indiana & Michigan Electric Co, also a subsidiary of American Gas, as proposed in American Gas' application for approval of the purchase of the common stock of Indiana. (Release No. 7788).

United Corp's plan for retirement of all outstanding $3 cum. preferred stock, calling for exchange of such shares for portfolio securities and cash, moved forward when the SEC recently denied three motions filed by objectors to the company's plan. (Release No. 7803).

Central Vermont Public Service Corp, a subsidiary of New England Public Service Co, has been authorized to issue and sell from time to time to First National Bank of Boston its promissory notes in amounts aggregating not in excess of $2,600,000. Proceeds will be used to repay the First National Bank of Boston sums already borrowed; for the repair and replacement of the company's properties destroyed or damaged by a flood on June 3, 1947 and for the construction and acquisition of facilities essential in the conduct of the company's business. (Release No. 7793).

Carolina Power & Light Co has been granted an exemption from competitive bidding with respect to issue and sale through underwriters to its common stockholders of 90,935 additional common shares in the ratio of one additional share for each ten shares held. In a supplemental order the commission approved an agreement which Carolina entered into with a group of underwriters headed by Merrill, Lynch, Pierce, Fenner & Beane of New York, whereby the latter would agree to purchase, at the offering price to the common stockholders, any unsubscribed shares. (Release No. 7802 and 7807).



Wherry Requests Review of Reclamation Spending

Another Congressional move to stave off a request for a deficiency appropriation for Western Reclamation projects was made last week (Nov 10) by Sen. Kenneth Wherry.

In a statement to the press, the Nebraska Republican, chairman of the Appropriations Subcommittee for the Interior Department, revealed that he had asked the Budget Bureau to review Reclamation spending. A preliminary Budget Bureau report, he said, showed that Reclamation had been spending money too fast on 19 projects.

The report covered expenditures of all federal agencies during the first quarter of the fiscal year—July, August and September. On some projects, the senator asserted, the Reclamation Bureau had obligated more than $1,000,000 above a "proper apportionment" of the funds available for the period.

He asked the Budget Bureau to investigate whether these "excess obligations" would require deficiency appropriations, stopping of work, or steps by which the excessive spending could be "absorbed" during the fiscal year.

Senator Wherry previously had protested to Interior Secretary Krug that the Reclamation Bureau was obligating its annual appropriations too rapidly in order to produce a need for a deficiency grant from Congress.

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Canadian Output Statistics

The Dominion Bureau of Statistics has released the following statistics of Canadian central electric stations in thousands of kilowatthours:

Period	1947	1946
Nine months	33,845,384	30,814,849
Primary	28,585,594	23,730,908
Secondary	5,259,790	7,083,941
Exports to U. S.	1,695,222	1,983,151
September	3,589,497	3,265,860
Primary	3,188,810	2,591,794
Secondary	400,687	674,066
Exports to U. S.	157,307	199,879
August	3,641,476	3,439,934
Primary	3,168,385	2,666,162
Secondary	473,091	773,772
Exports to U. S.	250,215	232,402

Other News

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Onward and Upward!

Despite the Armistice Day holiday and power shortages in certain sections of the country, output of central generating stations continued its upward climb during the week ended Nov 15. A new record of 5,084,340,000 kwhr was set—a record not likely to last out the month. For the corresponding week of 1946, the total was 4,699,935,000 kwhr. The previous week in 1947 the total was 5,057,455,000 kwhr. Edison Electric Institute in its announcement reported an 8.2 percent increase over last year for the United States.

Weekly Output, Millions Kwhr

1947		1946		1945	
Nov. 15	5.084	Nov. 16	4.700	Nov. 17	3.985
Nov. 8	5.057	Nov. 9	4.682	Nov. 10	3.948
Nov. 1	5.009	Nov. 2	4.628	Nov. 3	3.899
Oct. 25	4.964	Oct. 26	4.602	Oct. 27	3.937
Oct. 18	4.946	Oct. 19	4.540	Oct. 20	3.915
Oct. 11	4.958	Oct. 12	4.495	Oct. 13	3.934
Oct. 4	4.935	Oct. 5	4.478	Oct. 6	4.028
Sept. 27	4.956	Sept. 28	4.518	Sept. 29	4.039
Sept. 20	4.977	Sept. 21	4.507	Sept. 22	4.019
Sept. 13	5.053	Sept. 14	4.521	Sept. 15	4.106

Percent Change from Previous Year

	Nov. 15	Nov. 8	Nov. 1
New England	+ 7.9	+ 9.7	+ 9.1
Mid-Atlantic	+ 7.5	+ 8.7	+ 7.7
Central Industrial	+ 9.9	+ 9.5	+10.9
West Central	+12.7	+11.3	+11.7
Southern States	+ 7.6	+ 7.2	+ 8.4
Rocky Mountain	+ 7.3	+ 6.6	+ 5.4
Pacific Coast	+ 5.1	+ 3.8	+ 2.6
To all United States	+ 8.2	+ 8.0	+ 8.2

Electrical World

OPINION

France Can Produce

AS IT MUST TO ALL, criticism came to ELECTRICAL WORLD last week. Its source is Mr P. LeBourhis, managing director of Als-Thom, General Electric affiliate in France. He criticises the estimates of electrical generating equipment production we ascribed to France in an Oct 11 editorial. France, he says, can make 1,500,000 kw yearly, not the 400,000 kw we accorded her.

Mr LeBourhis' letter will be found on page 145. He summarizes by saying that "an annual average production of 1,500,000 kw could be reached by France during the next five years."

Inasmuch as Als-Thom alone will ship 450,000 kw this year, 200,000 kw of it thermal capacity, our figure was wrong. The point we made in our Oct 11 editorial, discussing the power portion of the Paris Report by the 16 Marshall Plan nations, remains valid. Mr LeBourhis insists that we were far too generous in guessing that western Germany could, under optimum conditions, produce 1,000,000 kw per year. Thus, the extra production with which we must credit France is largely offset by the loss from what we credited to western Germany.

It develops, also, that while France can make more turbine-generators than we had guessed, no one is willing to guarantee that it can all be put on the line. There is no guarantee that the necessary boilers, transformers, switchgear and, for waterwheels, the dams will be available. And Mr LeBourhis tells us that the 22,500,000 kw which the Paris report says Europe can provide for itself in four years may take five. Nor can it be done, he adds, without such U. S. aid as heavy construction equipment, machine tools, raw materials and perhaps some power transformers.

Well, of course, the manufacture of generating equipment which cannot be operated will cause just as great failure in the Marshall Plan as would be caused by the failure even to manufacture the equipment. More than ever, ELECTRICAL WORLD feels that those 22,500,000 kw will not be operating in four years. Thus, more than ever, it feels that the power portion of the Paris report is wrong and should not receive U. S. endorsement, lest it cripple our own power systems.

A Neglected Credit Item for the Heat Pump

BTU OUTPUT divided by the BTU equivalent of kilowatt-hour input is the coefficient of performance of the heat pump. But is that the full measure of heat pump performance?

It is not. On the average, it takes only two units of heat from a heat pump to replace three units from the ordinary house heating furnace. The ratio varies with the kind of fuel. For instance, let us say that the fuel burned to heat a house comfortably for one month contains 60,000,000 Btu. But the heat pump will keep the house just as comfortable in the same kind of weather with an output of only 40,000,000 Btu. The heat requirement of the house is reduced about one-third.

Now, why is that? Air for combustion is the answer. The missing 20,000,000 Btu just goes up the flue, literally. It helps to warm the neighborhood.

This obvious loss factor is included in comparative studies of costs of heat pump operation and of heating by combustion. It appears as a statement of combustion heating efficiency. But, so stated, it is merely an undefined element in an abstruse equation, with no appeal at all to the uninitiated. It is the uninitiated who comprise the potential heat pump market. They can be wrought up to a considerable pitch of excitement by careful explanation that for every heat unit the heat pump takes in in the form of electricity, it puts out three or four or five for keeping the family warm. That explanation would be much more effective as a selling argument if instead it showed that the heat pump made one heat unit of electricity the equal of four or six or eight paid for in the fuel bill.

Money for the Capacity

ESTIMATES of the amount of capital it will take to pay for the physical expansion of utility systems are being upped for two reasons. The rate of load growth is increasing. Costs are substantially greater than when the original estimates were framed.

Plans have been made for acquiring initial blocks of new money, but more thought should be given now to the method of acquiring the rest. The assumption generally seems to be that "ways will be found when the time comes."

Presumably, something like half the $5,000,000,000 required over the five-year period will be available from reserves and surplus additions. The other half will presumably have to be acquired by sale of proper proportions of bonds, preferred and common, or by some less conventional method.

Suppose, however, there is reluctance or resistance to the particular approaches devised as the present vague

plans take more definite shape. Against that circumstance, the investment officials of the industry should have a form of back-up protection like what the system engineers provide against electrical faults and short-circuits.

A possible back-up source that seems to have been given little consideration is one that can be keyed to a technical transition which is not too well recognized in official circles. Briefly, the accelerated trend toward unitized plant facilities warrants serious contemplation of the equipment trust as a means of getting capital for added capacity.

Railroads and urban transit systems resorted to the equipment trust when they sank into distress levels. They had large fractions of portable and retrievable rolling stock to offer as security. Electric utilities are not in distress, nor do they have much that can be classified as rolling stock. But they do have unit substations, standardized turbines, standardized switching stations, portable substations, factory-assembled switchgear of uniform pattern. Many could be considered retrievable by the investor who is prone to protect himself against collapse and bankruptcy—whether in the cards or not.

The point is that the financial vice-presidents, the attorneys and financial sources could well take a new view of the equipment trust as a possible resort in the electric utility field if the money flow slows up. It might prove to be a facile and advantagous way of satisfying the regulatory authorities that a form of instalment buying is just as feasible for utilities when they need system equipment as for the customer when he purchases the appliances that cause all the excitement.

One Way Would Be to Burn 30,000 Matches per Hour

BUT the Florida Power & Light Co does not recommend that way to heat homes in its service area. Neither does the company recommend electricity. In fact, so emphatically does the company *not* recommend electricity that it went to the trouble and expense of publishing and sending to its customers a two-color, 16-page booklet telling why oil should be used for home heating rather than electric power.

No wonder Florida Power & Light does not want its customers to fall too much in love with electric heating. The average south Florida year contains only 566 hours when home heating is needed. If all FP & L customers used electricity for that purpose, the system would have to be expanded to 7½ times its present size. The system load factor would be less than 20 percent. This is hardly a paying proposition at present prices, regardless of whatever future domestic electric house heating may have.

Which is why we see one of the most sales-minded power companies in the country turning its proven promotional talent to boosting a competitor's wares, strange as that may seem.

WASHINGTON COMMENT

W. B. WHICHARD

PROTECTION of public funds is the proper concern of every federal agency acting as a loan custodian. But the Federal Works Agency appears to be stretching that objective to the limit in urging the War Assets Administration to sell a government surplus generating plant to Oklahoma's Grand River Dam Authority.

Last February, FWA drew some criticism when it became involved in another deal involving steam generating facilities. The agency approved construction of a 60,000-kw plant by three Nebraska power districts, which already owed the federal government some $43,000,000. FWA silenced its critics by revealing financial and engineering surveys which indicated the project actually would improve security of the government's loan.

Now FWA contends that the $14,000,000 in GRDA bonds it holds for the U. S. will be similarly "improved" if the Oklahoma Authority obtains the surplus plant from WAA. But the Oklahoma situation differs vastly in several aspects from the Nebraska case.

In the first place, the Nebraska districts, who made showing of a critical need for additional generating capacity, are the sole source of energy supply for much of the state. GRDA never has held such status in Oklahoma. It is a state agency set up to operate Pensacola (Grand River) Dam for flood control and power. It never has owned or operated a steam plant. There is considerable question as to its authority under state laws to do so now.

Further, the privately owned utility company serving the area around the surplus plant also is attempting to purchase the property. The company is expected to match GRDA's $3,500,000 bid.

Even granting the contention that GRDA needs steam capacity to firm Pensacola's hydro output, it is difficult to conceive how the surplus plant would serve this purpose except at considerable additional cost to the Authority. The property is valuable chiefly for its substantial boiler capacity. Only two of its 5,000-kw generating machines have condensers. The other two operate at low pressure and feed steam for process use.

Public Service Co of Oklahoma, other principal bidder for the plant, wants to install a 30,000-kw turbo-generator, which it already has ordered, to make immediate use of the primary steam. It probably would use the two low-pressure units as toppers. GRDA does not even claim it could put the plant into service so efficiently.

Just why FWA is so insistent in this case is not precisely clear, despite its professed anxiety to "protect the government's investment." Agency spokesmen say that GRDA is meeting interest on its federal loan and setting aside ample funds to meet payments on the principal.

Generator Ratings and Load-Carrying

Satisfactory ratings of generating equipment should include consideration of actual load-carrying capacities . . . J. H. Foote suggests four new measures of equipment performance*

RECENT STANDARDIZATION of a series of ratings of steam-electric generators has resulted in a fairly consistent series of ratings covering a range of sizes at 3,600 rpm. But there still remains the matter of the compatibility of the kw ratings and actual load-carrying capabilities of the prime mover, the generator, and the system load which both will satisfy. Load which generators can be expected to carry at the time of peak should be the measure of the capability of those generators.

Practice has become increasingly prevalent, if not practically universal, of determining and expressing system load demands in terms of the average kilowatthours supplied to the load by the generators in a clock hour. Average kw load over the period of an hour is much superior to the momentary load as a measure of the service required of a generator or of its ability to serve a load.

At the same time, the prime mover driving the generator must be able to carry not only this average load but also the momentary swings of load which are in excess of this average. In small systems serving large fluctuating loads, the momentary peaks may at times exceed the hourly average by amounts approaching 10 percent. In compact metropolitan areas the maximum load within a clock hour may exceed the average by a considerable amount when, for instance, a cloud bank darkens the area for but a portion of the clock hour period.

Prime movers and generators must also be able to carry the station auxiliary power.

It must be assumed that some machines will have been recently overhauled and are probably in the pink of condition while others are approaching a period for scheduled maintenance and possibly operating a little short of their best performance. Variations in fuel and condensing water also have their effects.

Also, duty of frequency regulation must be shared by various machines; and during the life of any given generator it can be expected to run the gamut in the load despatcher's schedule: From favored pet at steady base load when new to work horse swinging into short-time peak periods when maturity has been reached.

It is suggested that the most useful, the most significant, and the most satisfying *rating for a generator* in the combined view of engineers, operators and management should be *that amount of the system's peak load which the generator can be expected to carry when called upon to do so during the major portion of its useful life and under the usually to be expected conditions of operation throughout the system.*

Such a rating should have a name. Perhaps a suitable designation would be "Dependable Net Capability." Definitions of this rating and of "System Load" which this amount of generation would satisfy might be formulated as follows:

System load shall be the integrated kilowatthours appearing at the power supply sources in any one clock hour and measured at those sources. It shall be the net load appearing thereat, not including generating station auxiliary power requirements.

Dependable net capability of a generator, generating plant, power source or system at any particular period shall be the system load which can be supplied thereby on the basis of the operating conditions expected to exist on the system at that time.

Such a capability rating of a generator would, however, be incomplete without the designation of other values designed to insure that capability is provided adequate to take into account the various factors outlined heretofore. Additional capability must be provided in the design to supply the needs of the following:

1. First is the operating condition factor, which recognizes that at any one time all plants on the system can not be expected to be able to carry simultaneously the maximum loads which they often can individually supply. This factor may derive from any number of circumstances of weather, condition of maintenance, quality of fuel, etc. It should not include outages of generators for maintenance, which constitutes an entirely separate consideration. Capability ratings of generators must assume that they are operating and supplying load.

If a name for the capability of an individual plant operating as part of a system but without benefit of this average operating condition factor be desired, it and its definition might be formulated as follows:

Maximum net loadability of a generator, generating plant, or power source constituting a part of an interconnected system shall be the maximum system load in net kilowatthours per clock hour which it can be expected to supply under the operating conditions normally to be expected to exist during that hour.

Obviously the sum of the maximum net loadabilities of the power sources will exceed the net dependable capability by reason of the operating

* Presented before the Edison Electric Institute, Electrical Equipment Committee, Philadelphia, Pa., October 7, 1947.

Capabilities of Utility Systems

condition factor described herein. At the same time, requirements of the load for regulation and for the momentary or other amounts of load variation expected to prevail within the hour have been provided for. Maximum net loadability contemplates the proper supplying of system load under good plant operating conditions.

2. The variation of the load within the hour, discussed in earlier paragraphs, the duty for which, in terms of rating, has been assumed to be spread among all the power sources, constitutes the second consideration.

Maximum net rating of a generator or generating plant shall be the maximum net steady output in kilowatthours per hour which under reasonable operating conditions can be supplied for a period of at least two hours, other power sources supplying any required variations in load within the period assumed.

3. Then there are the requirements of the generating plants for power to operate station auxiliaries, which may be supplied from a variety of sources but not considered a part of the system load.

If the prime mover or the generator supplies this auxiliary power, it is necessary to name and define the rating of the generator (or at least of the prime mover) in terms of its ability to carry this as well as the other loads imposed upon it. The sizes of steam, water and electrical pipes, conductors and equipment will then usually be based upon this rating. If special generators supply the auxiliary load and are operated in parallel with the main machines, they may be accounted a part of plant generation on their own account.

A name and definition might be:

Maximum gross rating of a generator or generating plant shall be the maximum gross steady output in kilowatthours per hour which it can produce under reasonable operating conditions for a period of at least two hours.

Table I

Typical Schedule of Generating Station Ratings at Time of Peak

Plant and No. of Unit	Maximum demonstrated gross output, Megawatts	Maximum gross rating, Mwh/Hr	Maximum net rating, Mwh/Hr	Maximum net loadability, Mwh/Hr	Dependable net capability, Mwh/Hr	Name-plate rating, Megawatts
	Individual units	Individual plants	Individual plants	Individual plants	Combined system	Individual units
Old plant (a)						
1	23	(22)			20	20
2	25	(24)			21	20
3	49	(46)			41	35
4	45	(43)			38	35
Modern plant (b)	(142)	135	128	124	120	—
1	46	(44)			37	35
2	46	(44)			37	35
3	68	(65)			56	50
New plant (c)	(160)	153	145	140	130	—
1	72	(69)			60	60
2	72	(69)			60	60
3	72	(69)			60	60
	(216)	207	198	189	180	
Totals	.....	...	(471)	453	430	

(a) Old plant—1923–1930 design with low-pressure, stoker-fired boilers and 1,800-rpm generators.
(b) Modern plant—1935–1940 design with high-pressure, pulverized-fuel-fired boilers, 3,600-rpm generators.
(c) New plant—1945–1947 design with high-pressure boilers and 3,600-rpm generators.
Note: Figures in parentheses do not constitute ratings on total abilities and are only for reference purposes.

Leeway provided in the design and execution of the machines by the manufacturers may be favorable or otherwise. It normally should be positive, with excess capacity, but on occasion it may be negative.

In the final determination of the dependable capability of the generator as a power source for the satisfying of system load, the knowledge of what the generator will do under proof conditions is of genuine value. It constitutes the reference upon which the other ratings can be based.

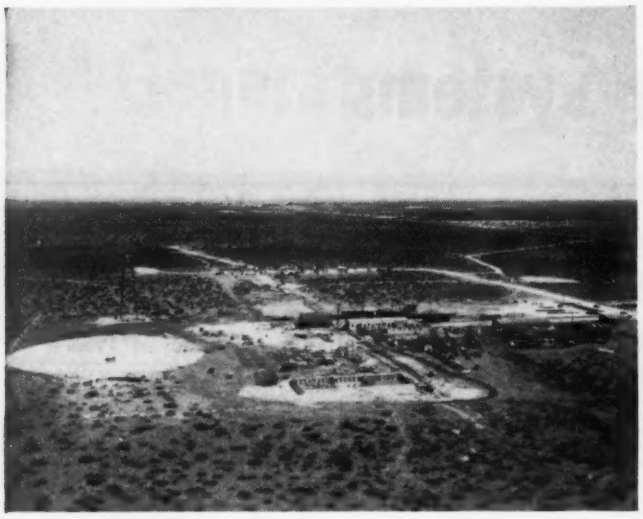
A name and definition for this reference rating might be as follows:

Maximum demonstrated gross output of a generator shall be the kilowatts produced while demonstrating its maximum performance under rated conditions when in first-class operating condition.

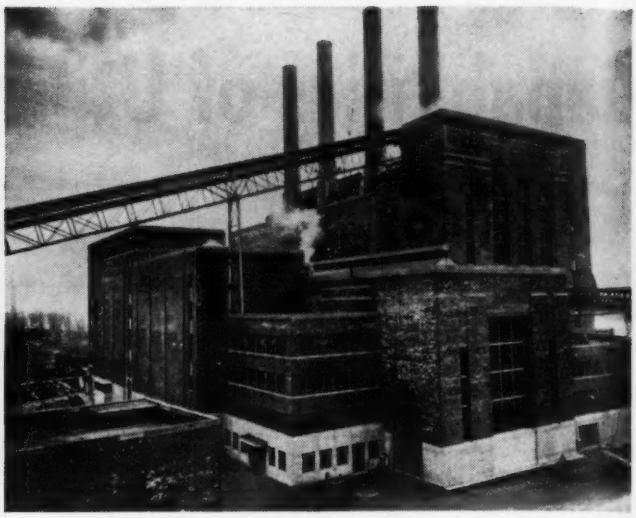
Three types of steam-electric generating plant are shown on the accompanying table to demonstrate the application of the ratings to old as well as to new designs and types of stations. The values are trustworthy but do not portray any particular system. Evolution proceeds from the maximum demonstrated gross output of the individual units to the really significant rating in terms of the satisfaction of system load: The dependable net capability.

The nameplate rating is the reference rating for purposes of purchase, guarantee, inventory and general use. The dependable net capability is the rating of genuine significance for purposes of budget and system load supply. It would seem desirable that they be as close, numerically, as feasible from a practical standpoint.

It is of interest that the nameplate and dependable net capability ratings for the generators for the new plant in the table coincide when the values for maximum gross ratings are 115 percent of the nameplate rating. This plant will employ four stages of extraction for regenerative feed water heating and will have moderate requirements for station auxiliary power. Some station designs may require a greater spread.



TEXAS IS TIGHT for many months to come, but another 25,000 kw near Monahans will help



ST. LOUIS DIVERTED 80,000 kw to another area during the war. Now, Venice No. 2 must pitch in

Shortages of Reserve Capacity

Why isn't 52,000,000 kilowatts enough to supply 1947 peak demands safely in all parts of the country? **Electrical World's** ***survey shows industry will squeak by this year and next, through an era of rapidly growing load, without too great loss or inconvenience to its customers***

THROUGH WAR and high prices, the American public and the industries which serve it have been able, at all times, to flip a switch and get—immediately—all the light and power they could use.

Thus, it will be surprising for many to learn what has been obvious for some time—that a few individuals, relatively, in some areas, are in some danger of having less than all the electric power they want when they want it.

That is a pretty well qualified description of the nation's electric power situation today. But the situation can only be described accurately if qualified. Never was qualification of any assertion more necessary than is qualification of a statement regarding the country's electric power situation.

To reach its own conclusions, ELECTRICAL WORLD surveyed 36 utilities, privately and publicly owned. It examined statistical margins of capacity. It sampled thinking of system operators. It projected the analysis into 1948.

The systems ELECTRICAL WORLD surveyed have 19,473,000 kw with which to meet a prospective aggregate of 18,020,000 kw of load. The average reserve margin is 8 percent. Other surveys show a reserve margin, country-wide, of only 5 to 6 percent. In some districts, reserve margins have just about vanished. Almost everywhere, system operators occupy distinctly uncomfortable positions. In general, the country's central station power plant approaches the 1947 peak with less reserve capacity than ever before in history.

What does all this mean?

It does NOT mean:

1. A nationwide brownout, blackout or shutdown.

2. Serious curtailment of industrial production.

3. Inconvenience to many individuals.

It DOES mean:

1. Continuing vigilance to keep generating equipment on the line without adequate maintenance time.

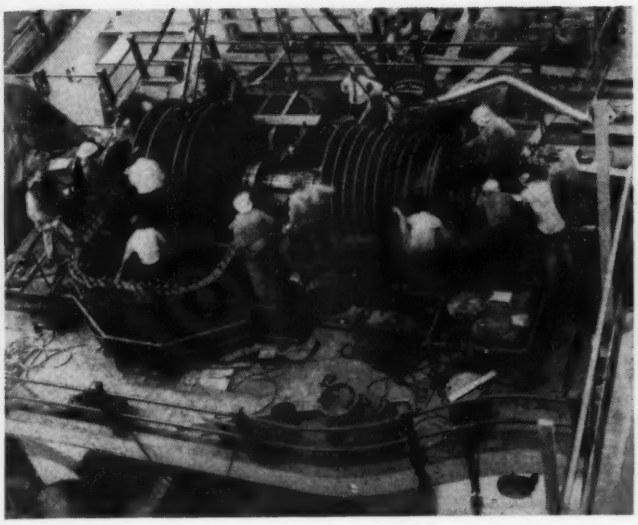
2. Operation of all possible interconnections at maximum effectiveness.

3. Planned, deliberate preparations for cutting off blocks of load—generally industrial, generally for a few hours daily at most—over a few weeks of the year for emergency purposes only.

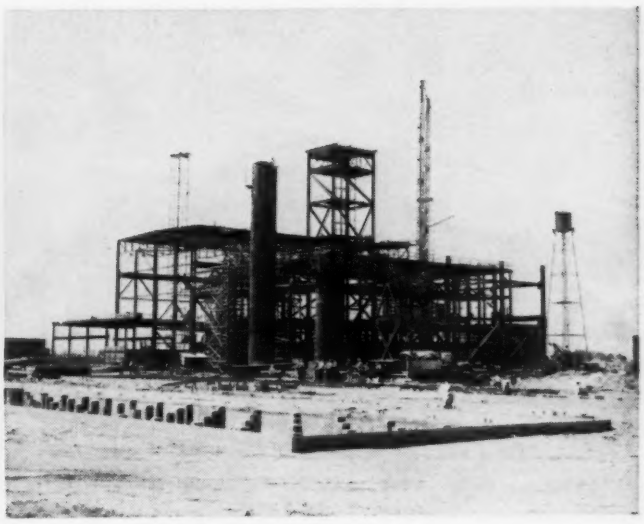
4. Planned reductions in voltage at strategic hours.

The risks are serious. They can be calculated in advance—all, at least, but those which enter the "Act of God" category. They can be faced with composure, serious as they are, because everything which could possibly have been done to avert risk has been done.

How did a situation arise which caught power capacity at 52 million kw when loads are expected to total



SOUTHERN CALIFORNIA rushed 22,500 kw into Long Beach station in 100 days to catch up with load curve



CENTRAL CALIFORNIA will have two units in new Kern steam station by midsummer of 1948

Tax Systems' Capabilities

some 49 million kw? Why did not system planners foresee and build adequately? Part of the answer lies back in the early war years, when the War Production Board fought for and won a policy of building as little generating plant as was absolutely required.

At no time since that policy was effected in 1942 has there been a possibility of building plant at a greater rate than actually has been accomplished. After V-E day, orders were released immediately to manufacturers. Others have piled higher ever since. Turbine builders and electrical manufacturers have been producing at peace-time record rates without satisfying the demand.

On the other side of the ledger, loads have increased by leaps and bounds. A war-time survey, considered optimistic at the time, anticipated that two years after V-J day, the country would be consuming kwhr at the maximum war-time rate and growth would then continue gradually. The record shows that war-time consumption rates were passed in almost exactly one year. The rate of growth for the ensuing year was nearly twice that which was anticipated.

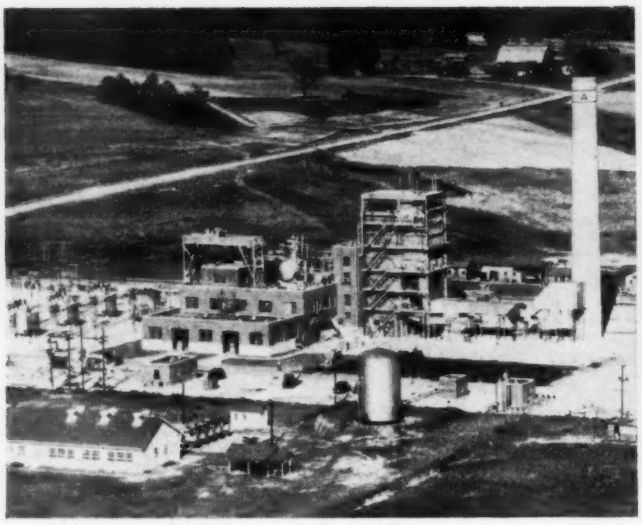
As late as June of this year, experienced observers estimated—on the average—a 10 percent increase for 1947 over 1946 in total kwhr generated. It is already obvious that this figure will rise to 13 percent or higher if everyone can have all the power he needs.

Thus, the electric supply systems have been caught in the same mesh as makers of steel, textiles, automobiles, petroleum products, other utility services and manufactured goods. A combination of unfilled pipelines, unprecedented production and growing new construction has skyrocketed power consumption beyond the dreams of power salesmen.

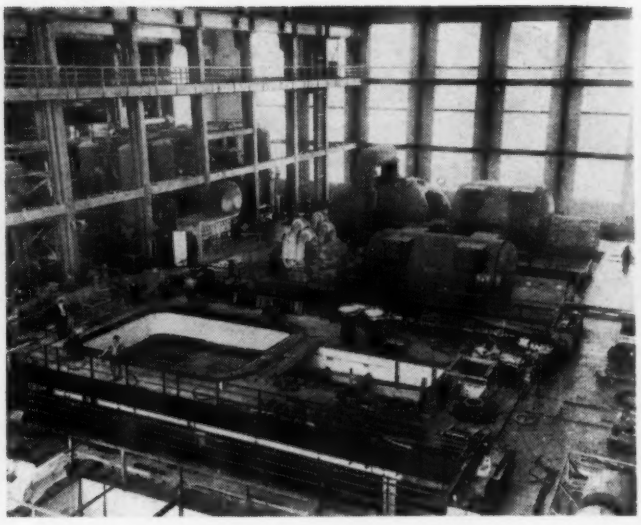
Still, unless a tired boiler gives up, or a worn turbine blade slips its moorings, the average American will be inconvenienced little if at all by the tightness of generating, transmission and distribution capacity available to serve him. The worst that can be expected is one or a series of local, temporary crises. Some of them will require that industrial customers get off the line for brief periods over the day's peak load—one to three hours, perhaps. If the trouble is very bad, a small section of a city may be cut off for a few minutes while circuits are juggled. This last possibility is hard to imagine unless major equipment breaks down, an eventuality which is no more likely in December than in mid-summer.

The steps which have been taken to ward off these interruptions are many. During this year, a number which were known, but which only rarely were used, have become relatively common. Some systems have experimented with reducing frequency to reduce load. Generally, they found that it did not yield any great saving and have abandoned it. More successful has been the reduction of voltage—which is easier and which cuts load more effectively. Even so, it is not popular with system operators. Twenty-one of the 36 utilities we surveyed expect to use the device this year—if necessary. Voltage reductions generally are held to 5 percent. Such a reduction by the systems ELECTRICAL WORLD surveyed would save only half a million kilowatts, or 4 percent of the peak they anticipate.

General experience indicates that a drop of 1 percent in voltage yields an average of 1 percent shrinkage in demand. Too great a drop brings operating trouble. Lowering voltage is now being and for months has been practiced by many systems. Undoubtedly, it will be a first resort



ARKANSAS BUILDS another 30,000 kw into Cecil Lynch to make a total of 90,000 kw of capacity



PHILADELPHIA will soon have another 169,000 kw at Southwark station to help carry the load

during peak periods which can't be carried by orthodox measures.

Much more important is the easing of peak load by arrangements to shift some industrial loads off the line during peak hours. Six of the 36 utilities expect to be able to shift 150,000 kw off their 2,000,000-kw peak. This is a saving of approximately 7½ percent.

We Chose Ships

THE QUESTION of why a stringency exists today in United States power supply has numerous facets. Essentially, though, it is explainable by two facts: (1) the U. S. deliberately, and beyond doubt wisely, virtually stopped building generating plants and transmission systems fairly early in World War II. Instead, it chose to build ships. (2) The nation emerged from the war and the first months of peace with an appetite for electric power too big for the most efficient and productive electrical manufacturing industry in the world to satisfy.

As the defense program accelerated in the winter of 1940-41, power systems were planning, spending, installing capacity furiously. But by mid-1941, power expansion had run head-on into the demands of other important programs. J. A. Krug, then the new head of OPM's Power Branch, called for standardization of equipment and the strategic "spotting" of new units where they would best help the defense program.

As war came closer, U. S. plans grew from a two- to a seven-ocean Navy. That meant turbines—and quickly. The merchant fleet burgeoned, too. By November, 1941, Navy orders alone delayed the utility program for six months.

Pearl Harbor brought new and increased orders for everything. Mid-January, 1942, brought production scheduling. Utility orders were among the first affected. SPAB put orders for 2,290,000 kw of land equipment on the books. It was less than utilities had on order by 500,000 kw.

There were must programs by the dozen—and each cramped power equipment. There were ships, rubber, aluminum, ammunition, rockets, landing craft, aircraft engines and everything anyone ever heard or dreamed of. Mostly, there were ships. Even the A-bomb program repeatedly threw power for a loss. About 240,000 kw went into Oak Ridge.

Late in February, ELECTRICAL WORLD told how Navy orders would delay a Chicago turbine for two months. In March, it noted that 290,000 kw more had been dropped from the order boards. Early May saw the headline, "Further Equipment Curbs in Prospect." Late in May, a signed story predicted flatly that the power equipment program for 1943 and later years would undergo sharp curtailment. In mid-June an order sharply limited production and use of new transformers.

The real blow fell in July. The pressure of war had finally been felt fully by the power industry. Its program for 9,600,000 kw of generating capacity, extending through 1945, was almost halved, and frozen at 5,300,000 kw. Virtually all of it was to be in operation by the end of 1943, the remainder early in 1944. All other work was suspended. Machines on which work had been started but which were not in the program were held "as is." Almost none of them were released for completion before V-E Day. From then on, it was struggle and "make-do."

The frustrations of the post-V-E Day period, when utilities rushed new orders, are too well known to need recounting. Had they been avoided, this winter's stringency might not exist. But they did occur—just as the war occurred earlier. Each cost the country considerable power capability. And we just haven't been able to make up lost ground.

FORT WORTH plant, with 50,500 kw installed, has already carried its share of 1947 peak

SYSTEM OPERATOR'S ingenuity in controlling pooled systems is worth more than a million kilowatts

Prior negotiation with industrial customers—in some cases also consultation with regulatory authorities—is being practiced. Utilities just won't pull switches in any event less critical than major breakdown. Even then, they would do so only as a temporary measure.

Many manufacturers can cooperate by shutting down heavy power-consuming equipment during peak periods. It can be done selectively without seriously hampering production. Electric furnace loads, for example, can be deenergized during melt-down periods. Shifting such loads as cotton gins, irrigation pumping and pipe-line pumping are in prospect.

Obviously, operators already have planned to utilize equipment to its maximum loadability. Without throwing caution to the winds, there remain spots where ingenuity and courage can derive an extra kilowatt without risking ruin of equipment. The wartime power pools, which spread reserves, are being extended fully.

Charity Begins at Home

Don't overlook what power companies can do within their own plants and offices to hold down peak loads. One company says "one of the best ways to secure relief, we have found, is to curtail power station uses such as coal handling to bunkers and storage during peak hours. Another is to shut down certain auxiliaries for plant use, and to restrict lighting. Restriction of all so-called power company uses in stations, substations, offices, storerooms, etc., has had a very salutary effect on employees and has brought a number of suggestions."

No Dimout

Anything approaching a dimout is contemplated by only a few companies. In each case, it is thought of as a last resort. Some companies may ask cooperation from large commercial lighting installations. Among other measures are certain war-time expedients—reducing whiteway lighting, cutting out signs and dimming window lighting.

Any broader movement would require appeal to the public. Most companies do not believe this will be necessary. Five companies expect they may have to ask public collaboration. More have plans ready in the event they are needed.

The majority will negotiate with individual customers before seasonal peaks arrive, to be ready if the pinch comes their way because of large-scale mishaps.

Some few also are buying industrial kwhr. where generating machinery can be operated, to reduce factory demands or actually to pump back into the utility system. Negotiations are under way to run power equipment at two U. S. butadiene plants even though this necessitates exhausting steam to atmosphere and results in high fuel costs. Small standby plants, almost obsolete, are being readied for operation by municipals and utilities that normally purchase their power.

Statistical surveys can only warn of general nationwide conditions. This one simply says that the capacity of power systems will be taxed to an extent greater than during the war—far greater than designers would feel satisfactory if they could control the situation.

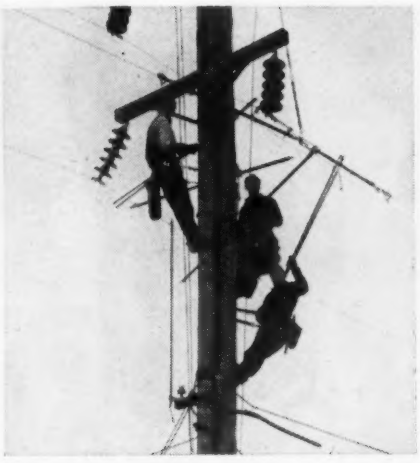
Through no fault of their own, power supply systems face the "calculated risk" of supplying most of their customers without a direct general appeal to conserve electricity. They feel they can handle the serious, but not desperate, situation without asking publicly for help. Rather, they accept the more practical and effective method of appealing to a few large industrial customers for temporary assistance.

Shortage Will Continue

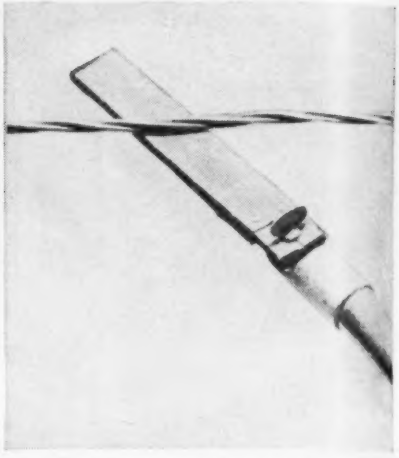
The shortage of reserve capacity will continue for at least one year, perhaps much longer. Generating units now being installed are already loaded. The "next machine" can hardly be put in service before loads grow to utilize all its much-needed capacity.

The nation as a whole will not suffer from a power shortage in the sense it has already suffered from a shortage of many raw materials and finished products. On the other hand, electric power being a commodity that cannot be stored, individual communities may be pinched for short or longer periods if the supplying utility's equipment fails.

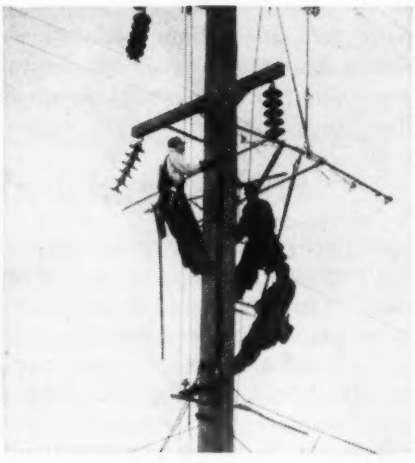
1 TENSION on conductor is transferred to link sticks and comealongs by ratchet screw supported from top arm. Jumper around burned conductor was installed first for safety



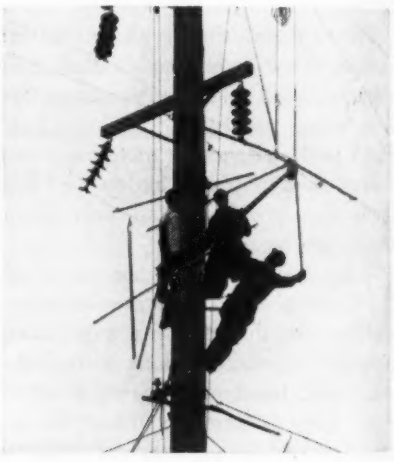
2 CONDUCTOR is held steady with wire tong and cleaned at points where joints will be installed



3 ONE cleaning tool is made by nailing carborundum cloth to board and fastening on end of universal pole



7 INSERTING new piece of conductor with a sleeve on each end, while being held with wire tong



8 COMPRESSING sleeve with roll-type splicing machine at connection on right side

Steps in Splicing A Hi-Line Hot

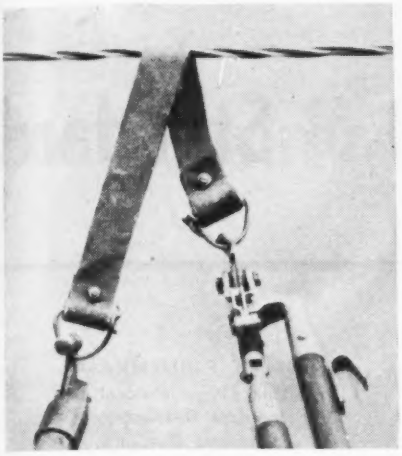
Detailed operations in the process of cutting out a burned section of conductor on an energized transmission line and splicing in a new piece, all with the aid of live-line tools

M. L. FISHER, Superintendent of Transmission, The Ohio Power Co, Canton, Ohio

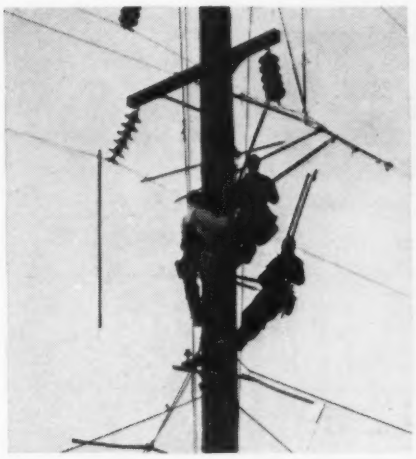
WHILE REPLACING POLES on one of Ohio Power's 66-kv lines without deenergizing the circuit, one of the conductors was found to be badly burned near the suspension clamp on the insulator string. The damage to the conductor was caused by a flashover. At this particular location, the new pole had been set in place alongside the old pole and the two tied together.

Before transferring the conductors and insulator assemblies from the old pole to the new one, it was necessary to repair the damaged conductor. Since it was desired to keep the circuit in service, a new piece of conductor was spliced in while the circuit was "hot." After the damaged conductor was replaced, the assemblies were transferred to the new pole and the old pole removed.

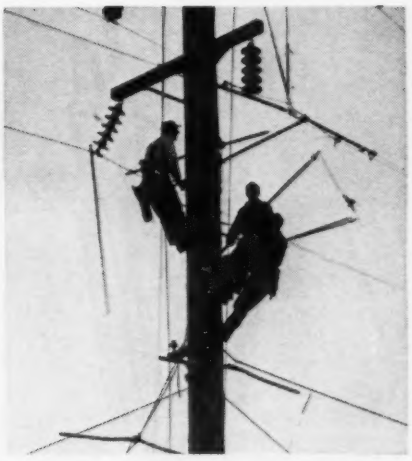
Successive steps in the splicing operation are shown in the illustrations.



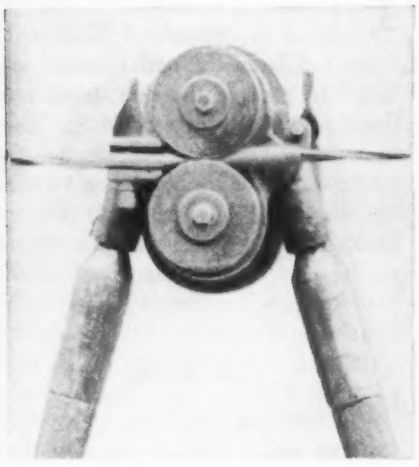
4 CARBORUNDUM cloth on sticks pulled alternately cleans far side of wire. Cloth reversed to clean near side



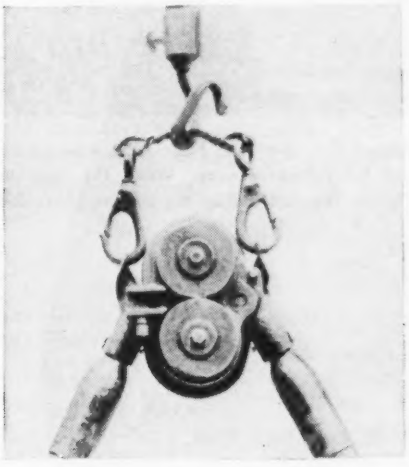
5 CUTTING OUT piece of damaged conductor by use of a tool known as a hot-wire cutter



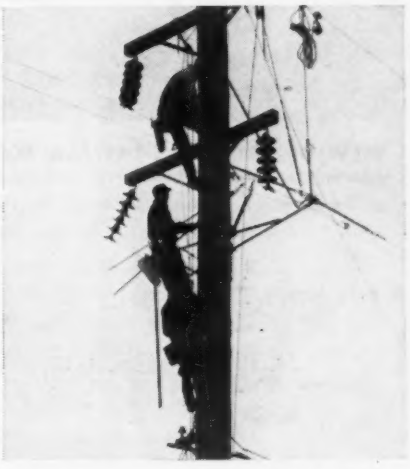
6 REMOVING piece of conductor cut out, shown being held with wire tong and plier tool



9 SPLICING machine of the roll type has wood insulating handles for linemen's protection

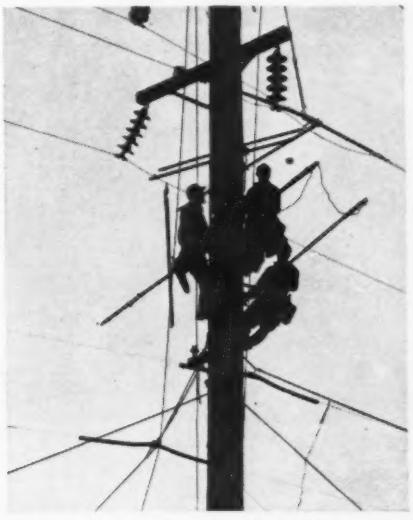


10 PROVISION is also made for supporting weight of tool from above to aid splicing



11 INSERTING line conductor on left side into sleeve on end of new piece of conductor

12 COMPRESSING sleeve on left side with roll-type splicing machine. This completes the connection for the insertion of new piece of conductor on the hot line

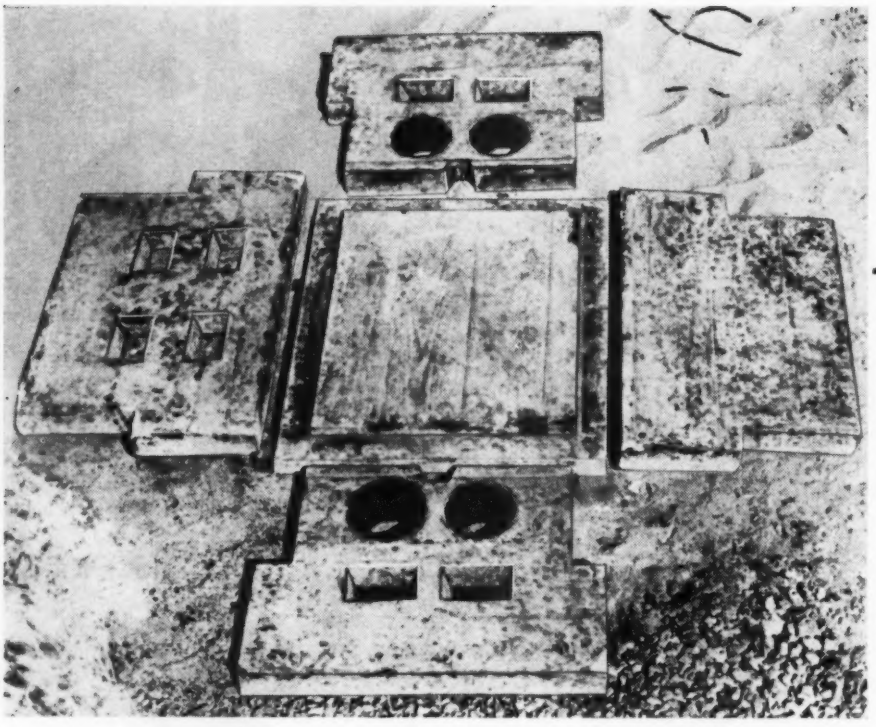


13 REMOVING jumper which was used to carry load until new piece of conductor was spliced in. Jumper is flexible copper cable with live-line tap clamps on ends

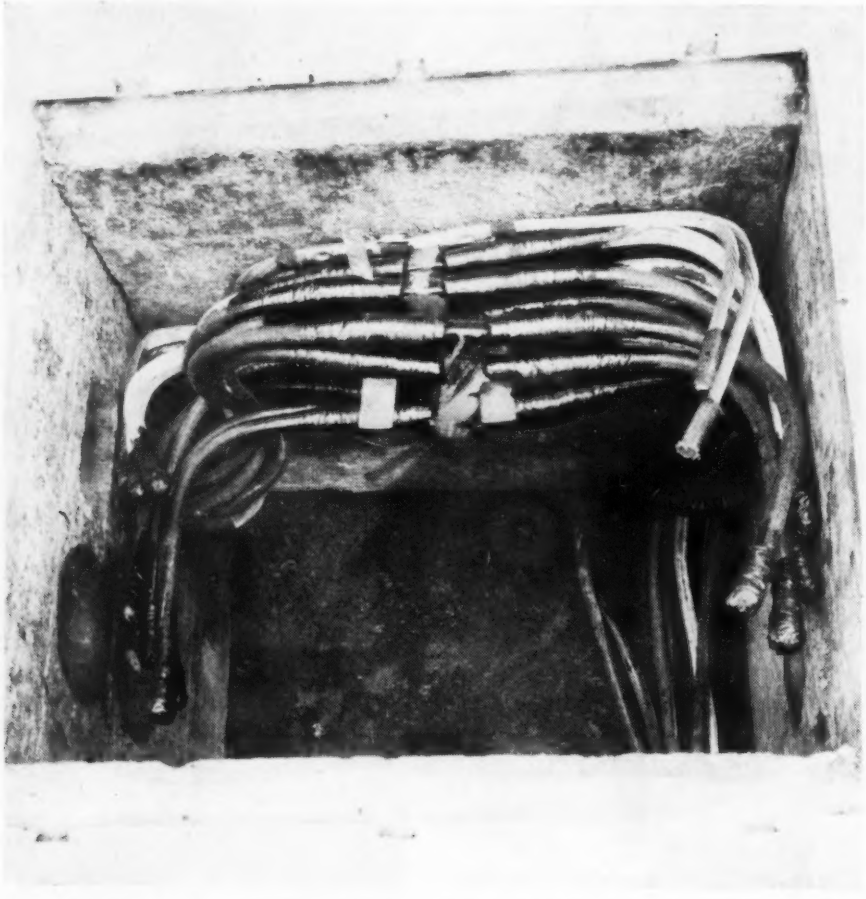
14 NEW structure after insulators were transferred, old pole removed

Standard

ROBERT F. BURNHAM
Assistant Superintendent of
Electrical Distribution
Stamford Division
Connecticut Power Co



VIEW OF PRECAST SIDEWALK BOX having five sections. Fiber bells have to be inserted for main ducts, inserts being provided for future services. When the location of the service is known in advance, the fiber bell is inserted during the casting operation



SERVICE BOX with secondary cables and Hycrabs installed. Splicer has inserted tails in Hycrabs to care for services when run in. When second 8-conductor cable is required it is racked on the wall opposite the first cable

THREE-PHASE, 4-wire, secondary service is available to all customers of the Stamford division in areas fed from the underground system. In part of the downtown area there is a secondary network. Other areas are fed by spot secondaries connected with the company's radial system. These secondaries are installed so that they can be cut over to the network system whenever the load density requires such action to be taken.

Curb Service

The division furnishes and installs conduit and cables to the curb line of the customer's premises. Existing facilities which are to be changed from the overhead to the underground system are picked up at the curb by the utility's conduits at a point straight out from the customer's service entrance switch. New services come directly to the company's service box, or on the property line nearest it. All company-furnished conduits are 4 in. in diameter, and may be fiber encased in concrete, transite conduit or galvanized steel. The size of conduit furnished by the customer must meet the code requirements for the service entrance switch. The conduit must be large enough to take four wires of the cable to be used even though the service may not call for a three-phase installation. The use of buried cable is not permitted where any part of the cable is owned by the company. This regulation is made for obvious reasons.

The company has set up the following standard sizes for services: 2-wire No. 6 or No. 1: 4-wire No.

Boxes Unify Underground Secondaries

Flexible layouts obtained with standardized road and sidewalk boxes . . . Provision for joining future networks . . . Cost relationships evaluated

6 or No. 1; 3-wire No. 6 or No. 1; and 4-wire No. 4/0. Services larger than four 4/0 require special consideration. If the company furnishes and installs the above standard cables, the customer is billed for labor and materials from curb to service entrance switch. Services can be fed directly from manholes, or from sidewalk and road boxes. These last are standard size (24 in. x 30 in.), with depth varied to meet field conditions. In some cases, the company has installed its secondaries on both sides of the street, usually running the main duct system on one side of the road with the services on that side supplied from the standard road boxes. On the opposite side of the road, all services are fed from sidewalk boxes. Sometimes the sidewalk area on both sides of the street is used for the duct system. In the main duct line, the box is placed to one side and the two top secondary boxes are offset to enter the box. Services can be taken from the sides or ends of the box, making for more efficient and practical use of service boxes.

Sidewalk Boxes

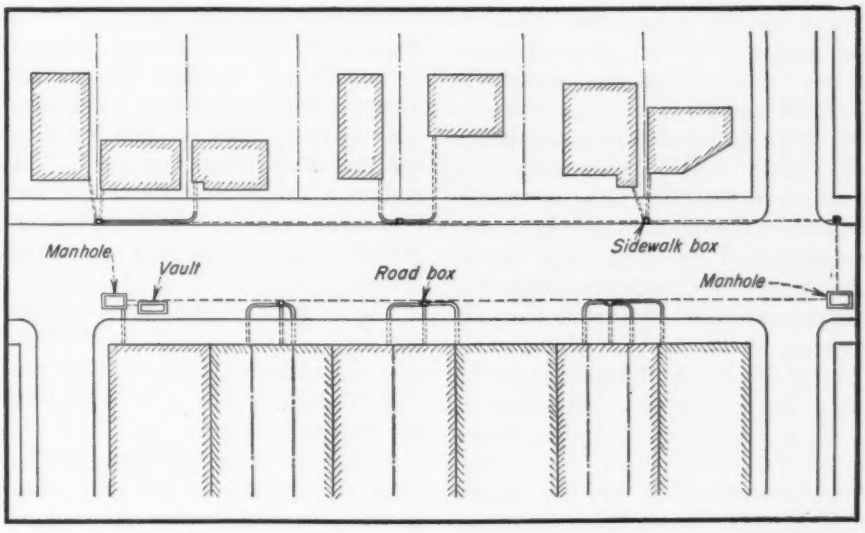
In sidewalk boxes, services can be taken from either end or the field side. Two ducts are run under the sidewalk with ties to manholes at road crossings. The sidewalk box is precast in five sections. Fiber bells are inserted for the main duct line. Inserts are provided for services, and wherever the location of the service is known in advance, bells are inserted as needed. Sides and bottom sections of sidewalk boxes are 3 in. thick, reinforced with 6-in. x 6-in. mesh. Concrete is a 1-2-3 mix, and the box cover is 1-in. Irving galvanized steel grating filled with concrete mixture of these proportions.

Road Boxes

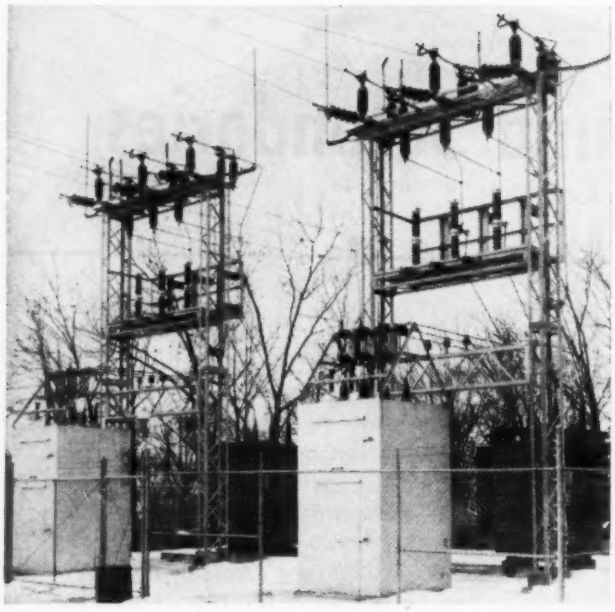
Road boxes have the same internal dimensions (24 in. x 30 in.), and may be precast in two sections, i.e., bottom and sides. The walls are 5½ in. thick, and are reinforced with ½-in. rods. The cover is standard 3-in. Irving decking. This grating is filled with concrete, in which bells are inserted before casting for the main ducts and services, as they are found to be needed for services.

On a recent job a sidewalk box, installed so that the services or service can be run directly in from the box, cost $126. When installed on the property line it is possible to serve two customers at this cost. If the company's part of the service exceeds 44 ft for two customers, it is more economical to install separate boxes. The company can run up to 86 ft for three services out of one service box, up to 129 ft for four services. Four services are the maximum that can be taken from one box, because of space limitations. These, however, are adequate.

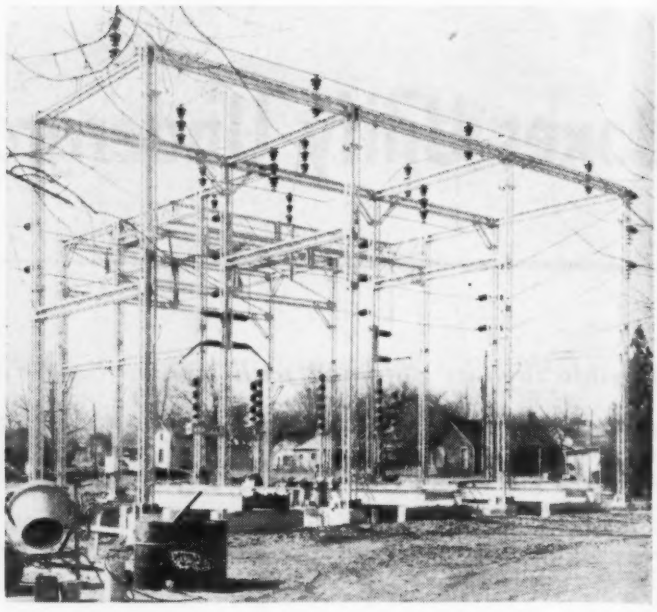
The cost of the road box for one or two services directly out of the side is about $260. Here the company furnishes up to 88 ft of 4-in. service conduit and cable before a second box is justified. For three services, it is more economical to use one box if the service conduit run does not exceed 175 ft; for four services, 263 ft of service conduit.



TYPICAL SECONDARY DISTRIBUTION SYSTEM with main duct line on one side of road, ties at road intersections, and duct line supplying customers on opposite side of street. Note transformer vault at left, sides being 4 ft 2 in. x 13 in. Solid lines indicate service conduit installed by company; dotted lines, by customers. SB—Sidewalk box; RB—Road box; MH—Manhole



COMBINATION of two or more distribution substation structure units may be made for various supply and feeder requirements



LARGE TRANSMISSION SUBSTATIONS are also erected by assembly of standard sections

Planned Substations Can Cost Less

E. V. SAYLES*
General Engineering Supervisor
Consumers Power Co
Jackson, Mich.

Planning and detailed design facilitated by assigned style numbers . . . Field assembly speeded with standard parts from stock . . . Substantial over-all savings accrue

EARLY EFFORTS in the design of a standard substation were concentrated upon structural problems. The original goal was to produce a single steel structure of fixed design and dimensions that would accommodate a limited range of transformer sizes of the most commonly used voltage. As in previous attempts, the desire to include too wide a range of capacity coupled with single and three-phase combinations of voltage regulators proved too much for a single design of structure. The Erecticon design of Consumers Power Co has standardized parts rather than the over-all structure. Complete structures of the desired dimensions can be assembled from a few structural units.

An accompaning illustration shows some of the one-line wiring diagrams of substations that can be assembled using the standardized structural parts. Because of the many substation combinations possible and the variety of wiring diagrams required, it was necessary to assign style numbers to each type of substation. Each of these numbers identifies the one-line diagram and the kind of transformers, voltage regulators and low-voltage switching equipment used. The system is easily understood and has been readily accepted by company engineers, construction and operating forces.

The use of the Erecticon design has reduced to utmost simplicity the routine for planning and building any new substation. The entire operation proceeds as follows:

1. The planning division decides upon the location of the substation, its one-line wiring diagram, voltage, capacity, voltage regulating and switching equipment. This determines the style number of the substation. Its estimated cost can be quickly determined by adding the cost of major equipment to the basic design cost.

2. Upon approval of the project, the design division selects the detailed one-line diagram and the layout drawing for the style of substation specified. A property plan is made showing the exact location of the substation on the lot to be used, with the location of incoming and outgoing circuits.

3. Standard bills of material corresponding to the style number are then attached to requisitions from which orders for material and equipment are written. These bills of material constitute four separate listings: Foundation, structure, electrical materials, and station items. The first three lists are standard mimeographed sheets. The list covering station items must be prepared for the particular station to specify major equipment, whether it is new or available, fence, circuit nameplates, etc.

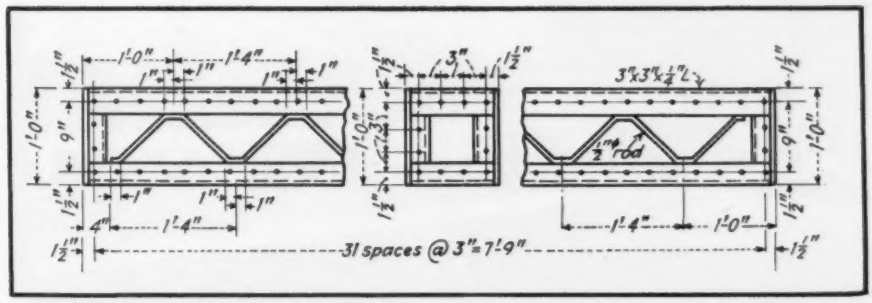
* "*Substation Design Remains Flexible With Erecticon Assembled Sections*" by Mr Sayles appeared in the November 8, 1947, issue of ELECTRICAL WORLD on page 106. This article presents further details on the applications of this construction technique.

4. Copies of drawings and bills of material are forwarded to the construction department. These include: Property plan showing general layout, fence, elevations, etc.; one-line and detailed wiring diagrams; standard drawings of foundation details and electrical layout showing equipment mounting (the electrical layout also serves as an erection drawing); and bills of material and manufacturers' prints.

The substantial savings in engineering costs for the Erecticon design are readily apparent. The elimination of steel design and detailing results in a large saving. The simplification of material ordering reduces the time required in the drafting room. The principal engineering work now consists of preparing the property plan. For distribution substations, one engineer and two draftsmen average about one complete substation per week. Maximum time required is about one man-month. This compares with about six or eight man-months for complete engineering on previous designs.

As the design of the distribution substation progressed on the basis of using standard structural steel parts, it became evident that the use of these parts did not need to be confined to the distribution substation alone. It became obvious that the parts could be assembled to form larger structures to accommodate almost any kind of switching equipment and bus arrangements of any voltage. A principal factor in this development was the early use of scale models of all proposed standard parts. With these it was possible to construct various styles of substations in miniature and to alter certain items to serve the greatest number of uses.

In assembling parts to form rectangular structures, many trusses are used as columns. Thus the original truss of 12-in. x 30-in. section is larger than necessary. For this reason a second truss was developed having a 12-in. x 12-in. section but otherwise similar to the 12-in. x 30-in. section. As in the original truss, bolt holes are continuous at 3-in intervals. Sections can be bolted end to end with internal bolts to form continuous lengths as desired. Lengths are available in 4-ft intervals up to 20 ft. Deflection charts have been calculated for various span lengths with both uniform and con-



ORIGINAL TRUSS DESIGN is modified to a 12-in. by 12-in. section for columns in large substation structures. A 7-in. diameter clear space within the section provides for conduit and other risers

ITEM NUMBER (MARK)	DRAWING TONNAGE (TOTAL WT.)	MANUFACTURING TONNAGE (UNIT WT.)	QUANTITY TO ORDER	MANUFACTURER'S NAME, CATALOG NUMBER AND DESCRIPTION	REQUISITION NUMBER	ORDER NUMBER
M-12A	2330	466	5	Columns and trusses, 12'-0" section		
M-16A	1184	592	2	Columns and trusses, 16'-0" section		
				Total Weight Welded Steel 3514#		
M-50A	172	43	4	9" channel (for column base)		
M-51	12	2	6	5" clip angle (for ladder and guard rail)		
M-52	40	5	8	9" clip angle (for column base)		
M-53	80	10	8	2'-6" side angle		
M-54	360	20	18	4'-11" side angle (for platform and H.V. switch and fuse)		
M-58	53	53	1	12'-11" platform angle		
M-64	351	117	3	14" x ½" x 4'-11" plate (for L.A. support - H.V.)		
M-65	27	9	3	8" x 3/8" x 11" plate (for L.A. bracket - L.V.)		
M-66	15	5	3	6" channel x 8" (L.A. bracket - L.V.)		
M-75	45	9	5	5" x ¼" x 2'-2½" bent plate (ladder bracket)		
M-98A	224	112	2	6" WF x 5'-3" (transformer rail)		
M-112R	28	14	2	3'-6½" bent angle (leg support - S.H.)		
M-112L	28	14	2	3'-6½" bent angle (leg support - Sw. House)		
M-113	68	34	2	6" channel x 4'-1-3/16" (channel support - Sw. House)		
M-114	98	49	2	6" channel x 5'-11¼" (switch support - Sw. House)		
M-115	17	17	1	6" channel x 2'-7¼" (brace channel - Sw. House)		
M-116	16	2	8	4" clip angle (for Sw. House)		
M-117	6	3	2	Tee bar (for Sw. House)		
M-121A	10	5	2	Tie rod assembly (for Sw. House)		
M-125R	46	23	2	5'-6" bent angle (lightning rod bracket)		
M-125L	46	23	2	5'-6" bent angle (lightning rod bracket)		
M-126	2	½	4	½" x 5" "U" bolt (for lightning rod)		
M-127	12	6	2	6" x 6" x 3/8" x 0'-5" angle (base angle for lightning rod)		
M-131	52	26	2	8" x 3/8" x 2'-6" plate (for switch rod guide)		
				Total Weight Misc. Steel 2058#		

STATION | G.W.O. | DWG. NO.

	A	B	C	D	E	F	G	H
BY								
DATE								
INSP.								
APP.								
DATE SENT TO CONSTRUCTION								

STRUCTURE
BILL OF MATERIAL
CONSUMERS POWER CO.
STYLE RTBP1 28' X 12'
TOP ASSEMBLY "A"

BILLS OF MATERIAL are assembled with a printed sheet for the style structure to be used. Other sheets are used for foundation and electrical equipment. Only one sheet is special for the particular substation

WELDED STEEL MEMBERS
COLUMNS, TRUSSES, KNEEBRACES ETC.

NO. PIECES	PIECE MARK	DESCRIPTION SHAPE	DESCRIPTION SIZE	LENGTH FT.	LENGTH IN.	USE	WT. PER PIECE	TOTAL WT.
	M4A	▭	12 X 30	4	–	TRUSS	200#	
	M4B	□	12 X 12	4	–	TRUSS	147	
	M6B	□	12 X 12	6	–	TRUSS	193	
	M8A	▭	12 X 30	8	–	TRUSS	331	
	M8B	□	12 X 12	8	–	TRUSS	240	
	M10B	□	12 X 12	10	–	TRUSS	286	
	M12A	▭	12 X 30	12	–	TRUSS	462	
	M12B	□	12 X 12	12	–	TRUSS	333	
	M16A	▭	12 X 30	16	–	TRUSS	592	
	M16B	□	12 X 12	16	–	TRUSS	425	
	M18A	▭	12 X 30	18	–	TRUSS	857	
	M18B	□	12 X 12	18	–	TRUSS	472	
	M20A	▭	12 X 30	20	–	TRUSS	722	
	M20B	□	12 X 12	20	–	TRUSS	318	
	M159A	⌞⌟	2@-3X3X⅛	4	0½	KNEEBRACE	45	
	M229A	○	1"@⅛, 2@2½	25	–	LIGHTNING ROD	123	
	M230A	⌞⌟	2@-3X3X¼	8	7½	KNEEBRACE	95	
	M234A	⌞⌟	2@-3X3X⅛	4	0½	KNEEBRACE	56	
	M256A	⌞⌟	2L-3X3X⅛	4	2½	KNEEBRACE	57	

TOTAL WEIGHT

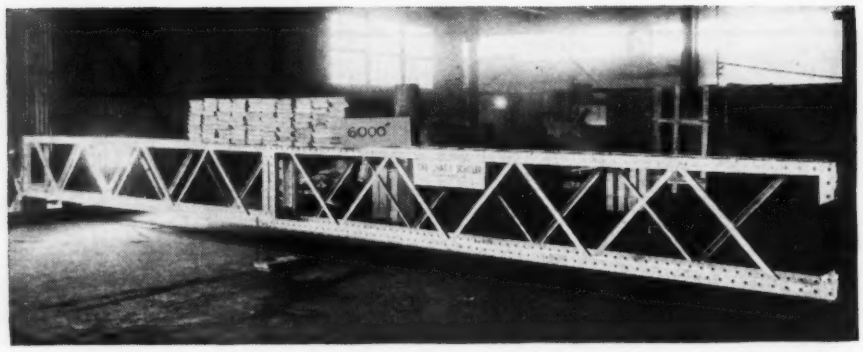
MISCELLANEOUS STEEL MEMBERS
CONNECTION ANGLES, PLATFORM ANGLES, SPLICE PLATES, LADDER BRACKETS ETC.

NO. PIECES	PIECE MARK	DESCRIPTION SHAPE	DESCRIPTION SIZE	LENGTH FT.	LENGTH IN.	USE	WT. PER PIECE	TOTAL WT.
	M50A	C	9"C@23.8#	1	8	COL. BASE ASSEMBLY	43	
	M51	L	3X3X⅛	0	5	CLIP ANGLE	2	
	M52	L	3X3X⅛	0	9	CLIP ANGLE	5	
	M53	L	2½x2½x⅛	2	6	SIDE ANGLE	10	
	M54	L	2½x2½x⅛	16	11	SIDE ANGLE	20	

MISCELLANEOUS STEEL MEMBERS (CONTINUED)
CONNECTION ANGLES, PLATFORM ANGLES, SPLICE PLATES, LADDER BRACKETS ETC.

NO. PIECES	PIECE MARK	DESCRIPTION SHAPE	DESCRIPTION SIZE	LENGTH FT.	LENGTH IN.	USE	WT. PER PIECE	TOTAL WT.
	M106	L	2½x2½x⅛	3	6	SIDE ANGLE	14	
	M107	R	3½ x ⅛	1	0	LIGHTNING BRACKET	3	
	M108	L	2½x2½x⅛	4	0	SIDE ANGLE	18	
	M109	R	5½ x ⅛	0	5½	GUSSET PLATE	2	
	M112R	L	2½x2 x ⅛	3	6½	BY-PASS SUPPORT LEG	13	
	M112L	L	2½x2 x ⅛	3	6½	BY-PASS SUPPORT LEG	13	
	M113	C	6 @ 8#	4	1⅞	BY-PASS SUPPORT	34	
	M114	C	6 @ 8#	5	11⅝	BY-PASS SUPPORT	49	
	M115	C	6 @ 8#	2	7⅛	BY-PASS SUPPORT	21	
	M116	C	2½x2½x⅛	0	4	BY-PASS SUPPORT CLIP	1	
	M117	T	ST 4"WF@12	0	4	BY-PASS SUP. TIE ROD BKT.	4	
	M124	>o-<	½" ROD	3	8⅝	TIE ROD ASS'Y.	7	
	M122	C	8 @ 8#	2	1¼	BY-PASS SUPPORT	17	
	M123	L	2½x2½x⅛	1	11	ROD GAP BRACKET	8	
	M124	L	2½x2½x⅛	1	5	ROD GAP BRACKET	8	
	M125R	L	2½x2½x⅛	5	8	LIGHTNING ROD BKT.	23	
	M125L	L	2½x2½x⅛	5	8	LIGHTNING ROD BKT.	23	
	M126	U	½	0	6⅜	U BOLT WITH HEX.NUTS	½	
	M127	L	6x6x⅜	0	5	LIGHTNING ROD BASE	6	
	M129	R	7½x⅛ BENT	0	8	CONDUIT SUPPORT CLAMP	4	
	M130R	L	2½x2½x⅛	7	3½	CONDUIT CLAMP BKT.	30	
	M130L	L	2½x2½x⅛	7	3½	CONDUIT CLAMP BKT.	30	
	M131	R	9x⅜	2	6	A.B. SW.OPER.ROD R.	29	
	M136A	I	5"WF X5@16.0	3	0	REG. RAIL ASSEMBLY	61	
	M156A	L	6 x6x⅜	1	0	BRACING CONN. ASS'Y	17	
	M161	R	6 x⅛	1	4⅜	KNEEBRACE CONN. R.	7	
	M162	R	6 x⅛	2	10⅛	KNEEBRACE CONN. R.	15	
	M163	R	6 x⅛	1	8⅛	KNEEBRACE CONN. R.	9	
	M164	R	6 x⅛	3	2⅛	KNEEBRACE CONN. R.	16	
	M166A	⌞⌟	3½ x 3 x⅜		3	BRACING CONN. ASS'Y	3	
	M171	L	2½ x2½x⅛	4	0⅝	INSULATOR SUP. BKT.	17	
	M172R	L	2½ x2½x⅛	2	6⅝	INS. SUPPORT BKT. ASS'Y	10	
	M172L	L	2½ x2½x⅛	2	6⅝	INS. SUPPORT BKT. ASS'Y		

SECTION of the complete planning and bill of material sheet for large transmission substations shows simplicity of detail planning. The number of pieces and the total weight are filled in for the standard parts required among a total of 103 items to cover the entire range of design

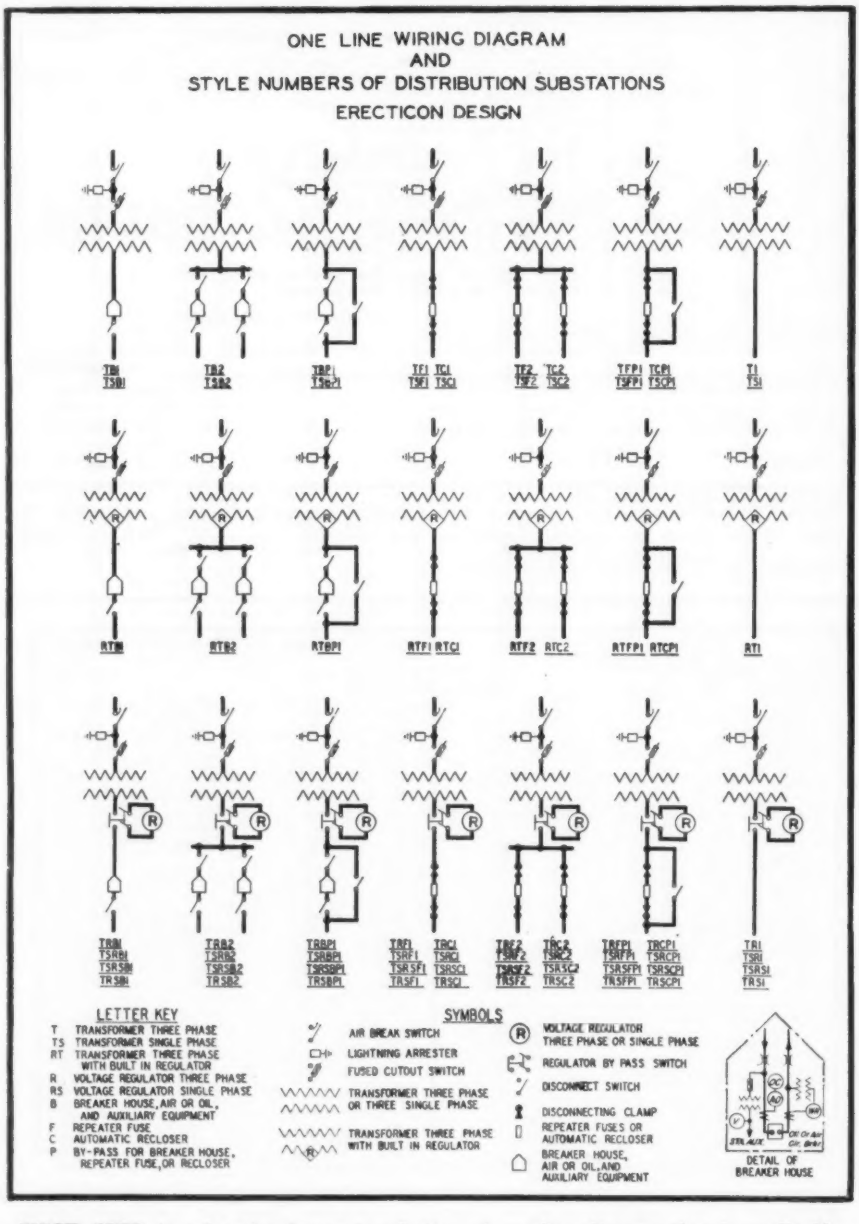


STRENGTH of truss section and bolted joint is demonstrated in this test with 6,000-lb concentrated load on a 32-ft beam made of two 16-ft members

centrated loadings. Tables have been prepared showing allowable loads and deflections for the commonly used construction applications.

To check the efficiency and strength of these arc-welded trusses, two 12-in. x 30-in. x 16-ft units were tested at the fabricating plant. Tests included uniform and concentrated loadings on both a single truss and on two trusses bolted together to form a single 32-ft unit. Cantilever tests to determine breaking strength of the 32-ft truss and its base mounting were also made. In all cases, the measured deflections were well within the calculated values. Upon completion of the tests, the undamaged trusses were regalvanized and used in subsequent construction.

With more than twenty-five substations of the Erecticon design now in operation, there has been sufficient opportunity to make cost comparisons with those of previous designs. Over-all savings have been substantial but vary considerably because of the previous design used, its voltage, equipment and number of circuits.

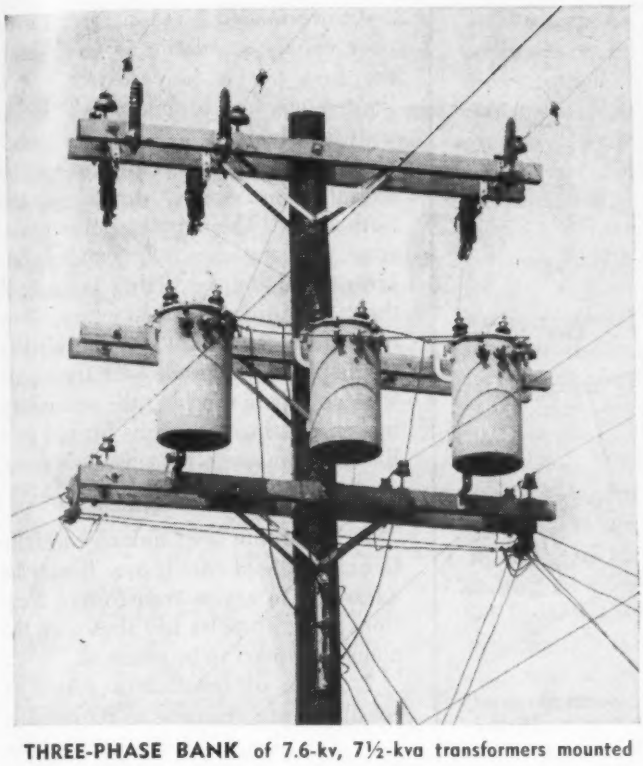

ONE LINE WIRING DIAGRAM
AND
STYLE NUMBERS OF DISTRIBUTION SUBSTATIONS
ERECTICON DESIGN
TB TSB1
TB2 TSB2
TBP1 TSBP1
TF1 TC1 TSF1 TSC1
TF2 TC2 TSF2 TSC2
TFP1 TCP1 TSFP1 TSCP1
T1 TS1
RTB RTB2 RTBP1 RTF1 RTC1 RTF2 RTC2 RTFP1 RTCP1 RT1
TRB TSRB1 TSRSB TRSB
TRB2 TSRB2 TSRSB2 TRSB2
TRBP1 TSRBP1 TSRSBP1 TRSBP1
TRF1 TSRF1 TSRSF1 TRSF1
TRC1 TSRC1 TSRSC1 TRSC1
TRF2 TSRF2 TSRSF2 TRSF2
TRC2 TSRC2 TSRSC2 TRSC2
TRFP1 TSRFP1 TSRSFP1 TRSFP1
TRCP1 TSRCP1 TSRSCP1 TRSCP1
TR1 TSR1 TSRS1 TRS1
LETTER KEY
T TRANSFORMER THREE PHASE
TS TRANSFORMER SINGLE PHASE
RT TRANSFORMER THREE PHASE WITH BUILT IN REGULATOR
R VOLTAGE REGULATOR THREE PHASE
RS VOLTAGE REGULATOR SINGLE PHASE
B BREAKER HOUSE, AIR OR OIL, AND AUXILIARY EQUIPMENT
F REPEATER FUSE
C AUTOMATIC RECLOSER
P BY-PASS FOR BREAKER HOUSE, REPEATER FUSE, OR RECLOSER
SYMBOLS
AIR BREAK SWITCH
LIGHTNING ARRESTER
FUSED CUTOUT SWITCH
TRANSFORMER THREE PHASE OR THREE SINGLE PHASE
TRANSFORMER THREE PHASE WITH BUILT IN REGULATOR
VOLTAGE REGULATOR THREE PHASE OR SINGLE PHASE
REGULATOR BY PASS SWITCH
DISCONNECT SWITCH
DISCONNECTING CLAMP
REPEATER FUSES OR AUTOMATIC RECLOSER
BREAKER HOUSE, AIR OR OIL, AND AUXILIARY EQUIPMENT
DETAIL OF BREAKER HOUSE

FIRST STEP in substation layout is selection of one-line diagram that is applicable. The style number is used as a key to the complete station layout drawings and bills of material that will be used in construction

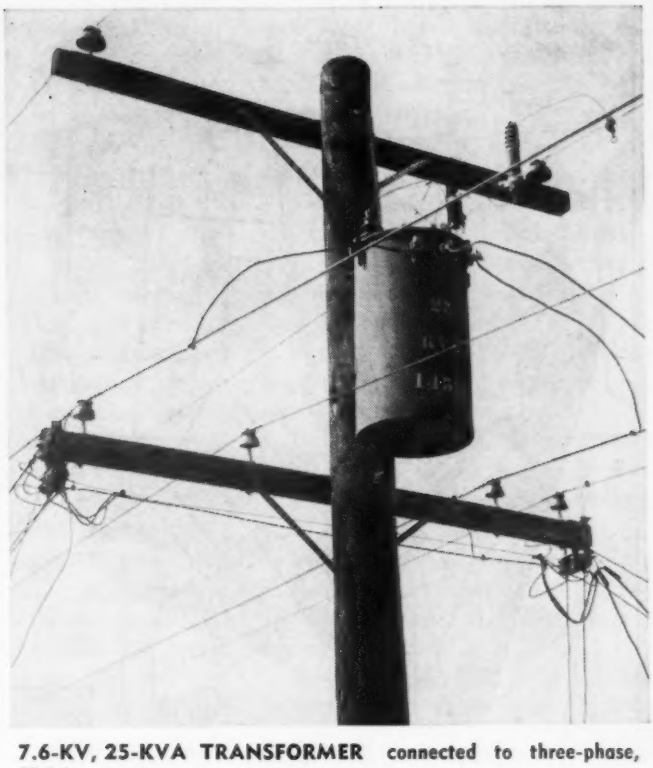
Reduced Steel Design

One of the principal reasons for standardization was the desire to eliminate steel design and detailing. This has been accomplished and has alone resulted in sufficient savings to justify the entire effort. There have also been substantial savings in structure costs. Accurate cost comparisons have been made with several common designs of distribution substations. The weight of Erecticon substations is about 75 percent of that of stations using standard rolled and bolted sections. This percentage also holds for large transmission substations using either rolled sections or bolted lattice-type trusses. In comparing over-all costs of the completed structure, the savings for either distribution or transmission substations are about 50 percent. This does not reflect quantity purchases or the availability of steel parts normally carried as standard stock items.

Counting each length as a separate standard part, five truss items will permit the building of any distribution substation. Only nine additional parts are needed for any transmission substation design. Thirty-one standard angle parts have been developed for various distribution substation combinations; seven additional parts are needed to complete the transmission substation requirements, In addition, four knee braces, seven channels, 27 plates, and 13 miscellaneous parts complete the set of 103 structural pieces that are customarily used in the construction.



THREE-PHASE BANK of 7.6-kv, 7½-kva transformers mounted on crossarm



7.6-KV, 25-KVA TRANSFORMER connected to three-phase, 13.2-kv circuit

Urban Areas Served at Generator Voltage

FRANK E. JOHNSON, JR
Asst Supt Electric Distribution
New Orleans Public Service Inc

Two-fifths of New Orleans transformer kva, other than network, now served at 7.6 or 13.2 kv . . . Start made on serving new residential districts . . . Cutover takes only minutes . . . New single-conductor cable designs being tried*

PRESENT PLANS contemplate installation of 23,000 kva of 7.6- and 13.2-kv single-phase transformers as a continuation of the program of converting the 2.3 and 4-kv circuits to these generated voltages. This will raise the present 8½ percent of the total non-network 135,586 kva of transformer capacity already converted to about 25½ percent, leaving only 43 percent still served at the lower voltages. A much larger percentage (31.9) of the total non-network transformer kva has already been converted to 13.2-kv service from banks on radial circuits and off substation supply circuits. Altogether 40 percent of such company-owned transformer capacity is being served at generator voltage.

These moves toward ultimate service of the city's urban area at voltages directly available from generators are aimed at achieving the following:

(1) A larger amount of kva can be carried for the same voltage regulation as for the lower voltage distribution. This is an important consideration with the present-day rapid growth in kva per square mile of residential load.

(2) In many cases use can be made of existing sub-transmission circuits to take over the 4-kv load. Thus, industrial, commercial and residential load can all be on the same circuit.

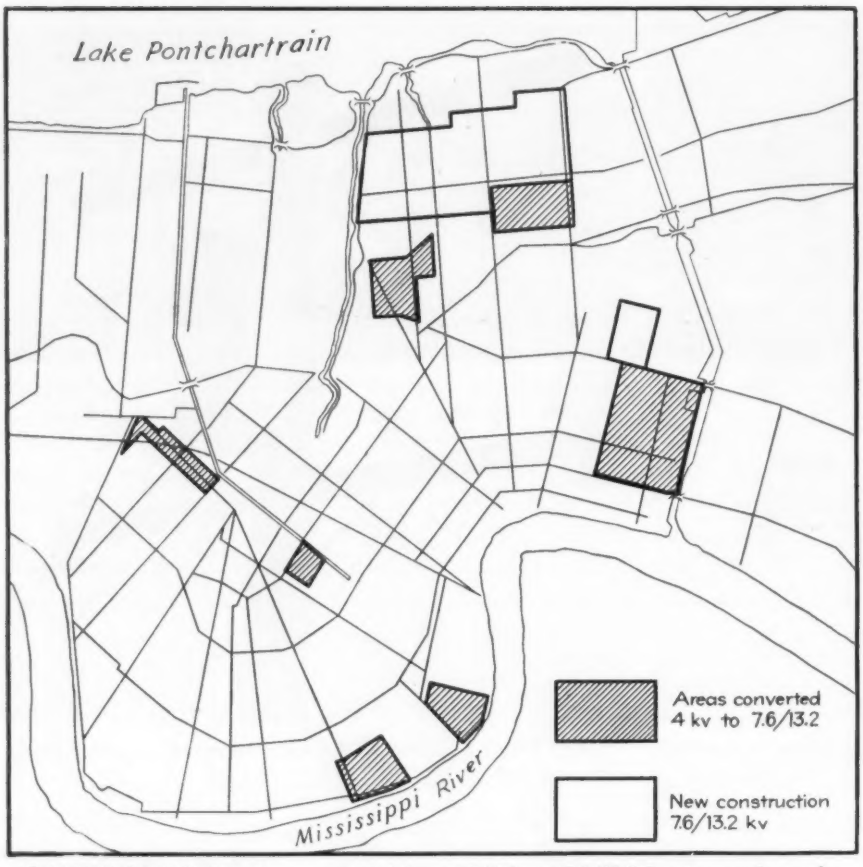
(3) Construction of additional 2.3/4-kv substations, or expansion of facilities in existing substations, can be avoided.

(4) Required additional transformers for load growth in 2.3/4-kv areas not yet converted can, to a large degree, usually be secured from transformers brought in from areas converted to the higher voltage distribution.

(5) The losses in the 13.2/4-kv transformation are avoided. Along with this are the parallel advantages of reduction in fixed charges on substation equipment, as well as the reduced maintenance and operation costs of the substation personnel and equipment.

(6) Fewer circuits on pole lines are required. With only one primary voltage along a trunk-circuit right-of-way, lower height poles for new construction can be used. With the gradual elimination of circuits from the substations, a congested situation near the substations is removed. This results again in lowered distribution maintenance costs.

* Adapted from paper presented at recent meeting of Engineering and Operation Section, Southeastern Electric Exchange, in Augusta.



SHADED AREAS have been converted from 2.3/4 kv to 7.6/13.2 kv; two newly established areas also shown

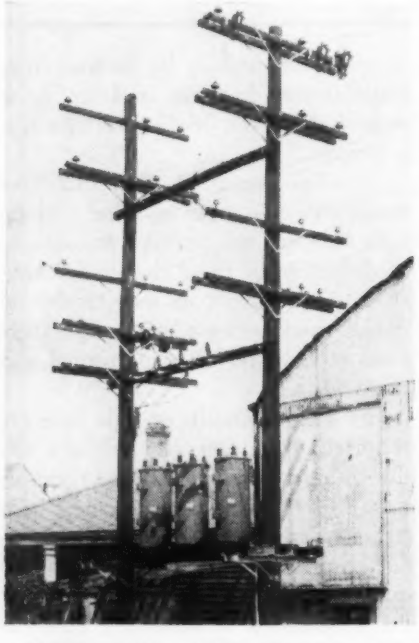
Insofar as 13.2-kv circuit loading from the generating station end is concerned, it is immaterial whether the load is concentrated exclusively at the substation, is distributed along a radial feeder, or is a combination of both of these conditions.

Double-circuit lines, as well as nearby radial circuits, supply emergency ties for these customers when required by circuit outages through either manual or automatic 13.2-kv throwover equipment.

At the present time, the connected company-owned transformer capacity on the various classes of distribution can be summarized as follows:

4,000-v System (Fed from substations exclusively)	80,810 kva	(59.6%)
13,200-v System (13,200-v transformers in banks on radial circuits and on substation supply circuits)	43,191 kva	(31.9%)
13,200-v System (7,620-v transformers supplying residential, smaller industrial and commercial customers)	11,585 kva	(8.5%)
TOTAL (of radial)..	135,586 kva	100.0%
A-C Underground 120/208-v Network System	48,425 kva	
TOTAL, All Systems	184,011 kva	

Thus, about 40 percent of the total possible kva of company-owned transformers that could be on direct feed at generator voltage has been converted to this voltage. Of an original total of 42—2.3/4.0-kv circuits, two have been completely changed over, three have been about 50 to 65 percent changed over, and spot loads have been converted over on the 37 remaining circuits.



THREE-PHASE BANK of 13.2-kv, 50-kva transformers on platform

An overloaded 2.3/4-kv circuit with poor voltage regulation is, in general, the first to be converted. Since a limited amount of manpower is usually available, a step-by-step "chopping off" of the circuit, lateral by lateral, is necessary, starting at the farthest end. The existing poles, crossarms, primary wire and secondary bus are re-used for the higher voltage, if their condition is satisfactory. New extensions at 7,620 v, if initially single-phase, are made with the single wire on a pole top pin; the secondary bus on existing crossarms for old pole lines, or on racks for new pole lines.

Procedure Sequence

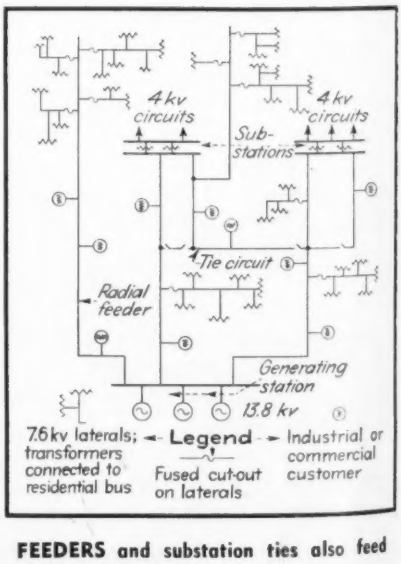
1. The route is examined carefully to observe field conditions. It may be advisable to revise transformer locations; certain poles not shown on the plans may need to be changed.

2. Poles of insufficient height or condition are changed as required.

3. The line is re-insulated to the 7.6/13.2-kv level by changing the pin and dead-end insulators. The new 7.6-kv transformers, lightning arresters, fused cutouts, etc., are hung on the poles specified. Everything is placed in readiness but the fused cutouts are left open, so that the transformers are not energized.

In a very few cases, it may be necessary to increase the primary wire sizes. If so, this work would be carried out concurrently with that above.

4. If an extension is required from an existing 13.2-kv circuit to reach the conversion area, this extension is made and the disconnect switches or



FEEDERS and substation ties also feed major customers

fused cutouts at the tie point left open.

5. The power or commercial customers affected are notified as to date and time of expected interruption. Preference in setting this time is given to those who will be most affected by the outage. The available manpower is spread out to give each man a definite job at the time set. The work is done in order; the most urgent transformers are connected first.

6. All the 2,400-v transformers, power and light, are disconnected from the primary and secondary, so that the secondary is dead. Where a power bank is involved, customer's main switch is opened.

7. The 7.6/13.2-kv primary is energized.

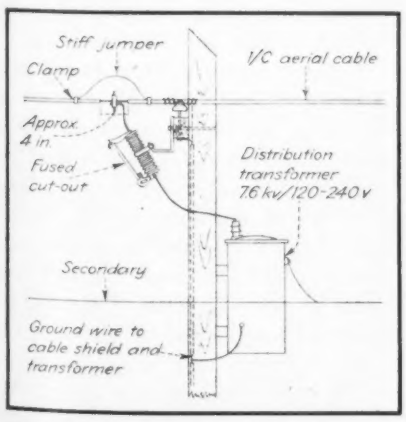
8. The 7.6 or 13.2-kv transformers are energized, and voltage test on secondary side is made to verify taps. Where power bank is involved, phase rotation is checked with phase rotation meter to conform to phase rotation test previously made on old 2.3/4-kv transformers.

9. Secondaries of the 7.6 or 13.2-kv transformers are then connected.

10. The old transformers and equipment are removed.

All of this may appear quite complicated. But the job can be done quickly if properly planned and executed. The interruption time for the average residential or small commercial or industrial customer is usually only a matter of a few minutes.

In some places the tree situation is so bad that "tree wire" or aerial cable must be used. A suitable type of *single* conductor, non-leaded, self-supporting cable *without* messenger wire would be more desirable for urban distribution at 8 kv to ground where span lengths are 150 ft or less, than the cumbersome, expensive, and complicated three-conductor aerial cable now offered by the manufacturers. Such a cable would have a distinct advantage for use in conversions to 7.6 kv from a 2.3/4-kv system existent on cross arms. It would replace the 4-kv tree wire already in use; would be easily tapped for single-phase distribution transformers for secondary bus feed, or for laterals, without the necessity of expensive splicing; and would eliminate excessive tree trimming to provide clearance for bare wire operating at 13.2. At the time of installation of such an aerial cable, prepared taps would be made for present needs and provisions would be made for future requirements, at least one tap per block for a later transformer installation.



PROPOSED METHOD of tapping 8-kv aerial cable for transformer. The jumper and clamp are omitted if cable is of unshielded type

Service requirements for residential customers do not permit an outage of a feeder or a lateral each time a transformer is to be connected or disconnected. Efforts should be made to do this work with the circuit alive. An unshielded cable at this voltage could be tapped at any time while energized, if an exposed section of the bare copper, 4 to 6 in. long, is left "in the clear" near the crossarm at the time of installation. Thus, a simple clamp on one end of a jumper (the other end tied in to the transformer fused cutout) could be readily connected to, or disconnected from the cable at any time by the use of a switch stick.

A possible simple installation of a single-phase distribution transformer on such an 8-kv aerial cable is shown in an accompanying drawing. If the cable must be shielded, a stiff jumper, as shown, must be provided to connect the shielding from one side of the tap to the other. By using a tapping connection similar to this, the special splicing arrangements are eliminated. Thus, it is a relatively simple matter to work the job "hot."

This cable must have insulation that will resist moisture and sunlight, and have high dielectric strength. If unshielded, its charging current to earth must be held to values comparable to that of the present 4-kv tree wire, to prevent radio interference.

Proposals for such a cable have been submitted to manufacturers by New Orleans Public Service. Four trial lengths from four different manufacturers have been ordered. Each manufacturer has submitted a different type of insulation, and after a trial of each, it is hoped that a satisfactory design will be obtained.

The following trial designs are being manufactured, and will be installed when received:

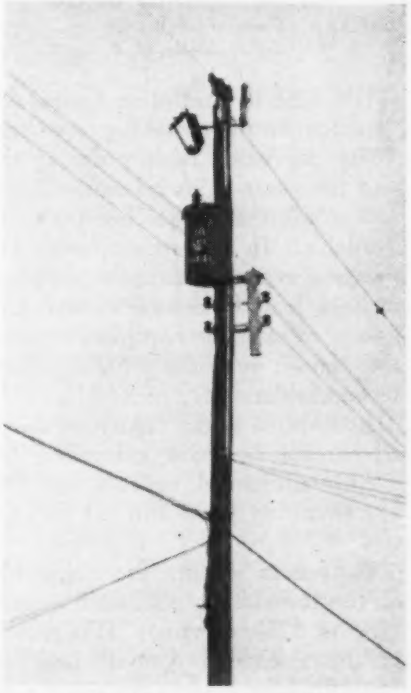
Type 1—#2 AWG, hard drawn solid copper wire insulated with 10/64-in. Flamenol.

Type 2—#2 AWG, 1/c, stranded, hard drawn, copper cable, insulated with 0.140-in. polyethylene and with 4/64-in. Nylon jacket.

Type 3—#2, 1/c, solid, hard drawn copper cable with 10/64-in. 16/64-in. Kerite and with 7/64-in. neoprene jacket.

Type 4—#2, 1/c, stranded, hard drawn copper cable with 10/64-in. Okovox insulation and 5/64-in. Okoprene jacket.

Until the single-conductor, 8-kv tree wire "proves out," and where tree conditions prevent installation of the bare 7.6/13.2-kv laterals, 13.2/4-kv transformer banks are used to transfer a portion of the load from the end of the overloaded 4-kv feeder. The bank is located where convenient, and may be on a platform or mat, depending upon the size required.



7.6-KV, 10-KVA TRANSFORMER is connected to single-phase, 7.6-kv wire on pole top-pin. Secondaries outrigged to pass case

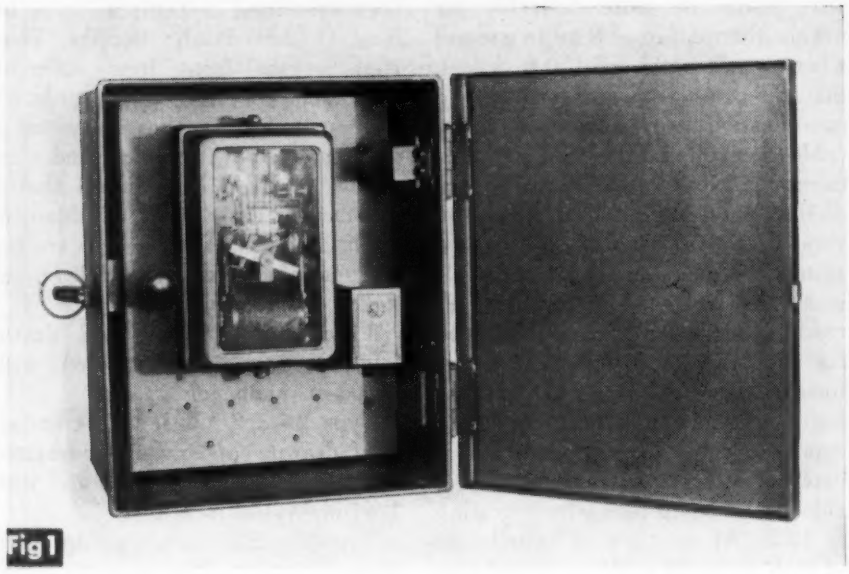


Fig 1

SINGLE-STEP automatic current control equipment for capacitor switching. Non-adjustable time-delay devices are mounted on the back of swinging panel

Fig 2

INSTALLATION of a 3-step automatic kilovar control for capacitor switching

Selection of Control Equipment for Automatic Switching of Capacitors

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THE USE of control equipment for automatically switching capacitors has increased rapidly during the past few years. This is because application information has become more available. In industrial plants, capacitors are automatically switched at light load to reduce voltage and losses; to meet the requirements of a rate clause; or to comply with utility recommendations.

In addition to the capacitors themselves, automatically controlled capacitor equipment consists of: (1) The switching device and (2) the control.

Capacitors usually are connected on the low-voltage utilization system (230 to 575-v service). This results in the maximum over-all benefits. The switching devices are either contactors or air circuit breakers. For service voltages of 2.4 to 13.8 kv, power circuit breakers are used for capacitor switching operations.

The control receives the signal, interprets it, and operates the devices that perform the desired change. The control consists of the following:

1. *Master Element.* This may be responsive to voltage, current, kilovars, etc.

2. *Time-Delay Device.* This mechanism is a practical necessity for avoiding unnecessary operation during momentary signal changes. Two of these are usually furnished so the time delay when switching ON or OFF can be set independently.

3. *Sequencing Device.* This is necessary only for multi-step control. It determines the order in which capacitors are switched in and out of service. It is usually a motor-driven selector switch.

4. *Miscellaneous Devices.* These include auxiliary relays, automatic-to-manual transfer switches, close-and-trip switches, etc.

The number and type of controls depends on the operating flexibility desired. Fig 1 shows a simple single-step current control for use with a contactor for switching. The time delay devices are non-adjustable. Transfer switches are not used. A 3-step kilovar control is shown in Fig 2.

The most common types of master control elements are: Voltage, current, kilovar, time switch, and motor-starter (motor and capacitor switched as a unit).

The types used for industrial applications are: Current—single step; kilovar—generally multistep; and voltage—single step or multistep.

A power-factor control is not recommended, even though capacitors are used for power-factor improvement. The reason for this is that the load kilovars vary directly with load kilowatts at constant power factor. Thus the control must be made inoperative when the load kilovars are equal to the capacitor kilovars, to avoid hunting action of the control.

The current- and voltage-responsive master elements are essentially a contact-making ammeter and voltmeter respectively. The kilovar-responsive device is considered a contact-making wattmeter operating on

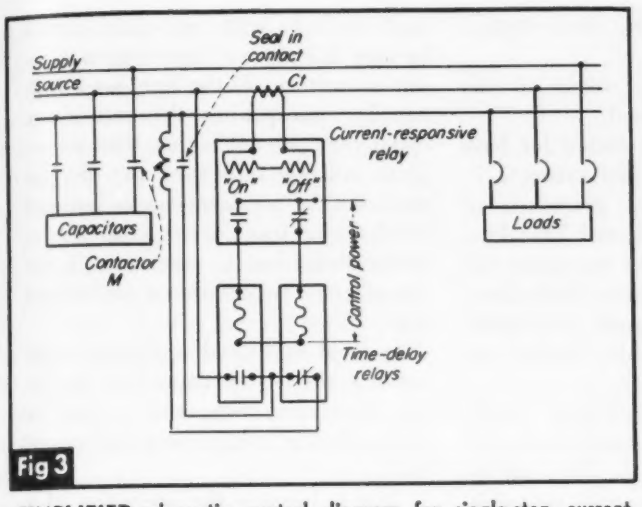


Fig 3

SIMPLIFIED schematic control diagram for single-step current control for contactor switching device

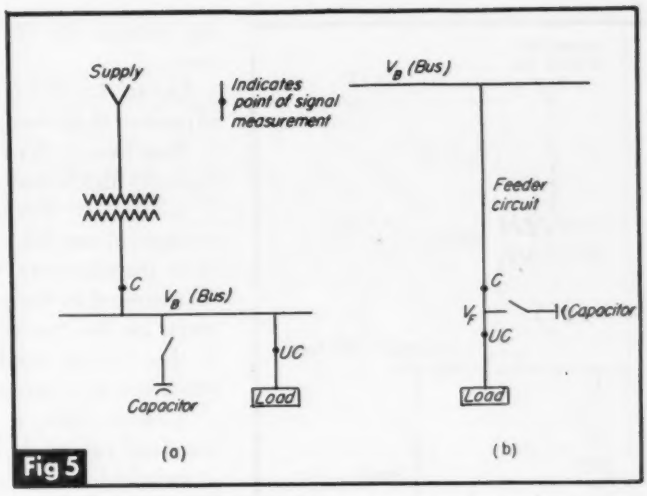


Fig 5

LOCATION OF CAPACITORS and point of signal measurement are shown

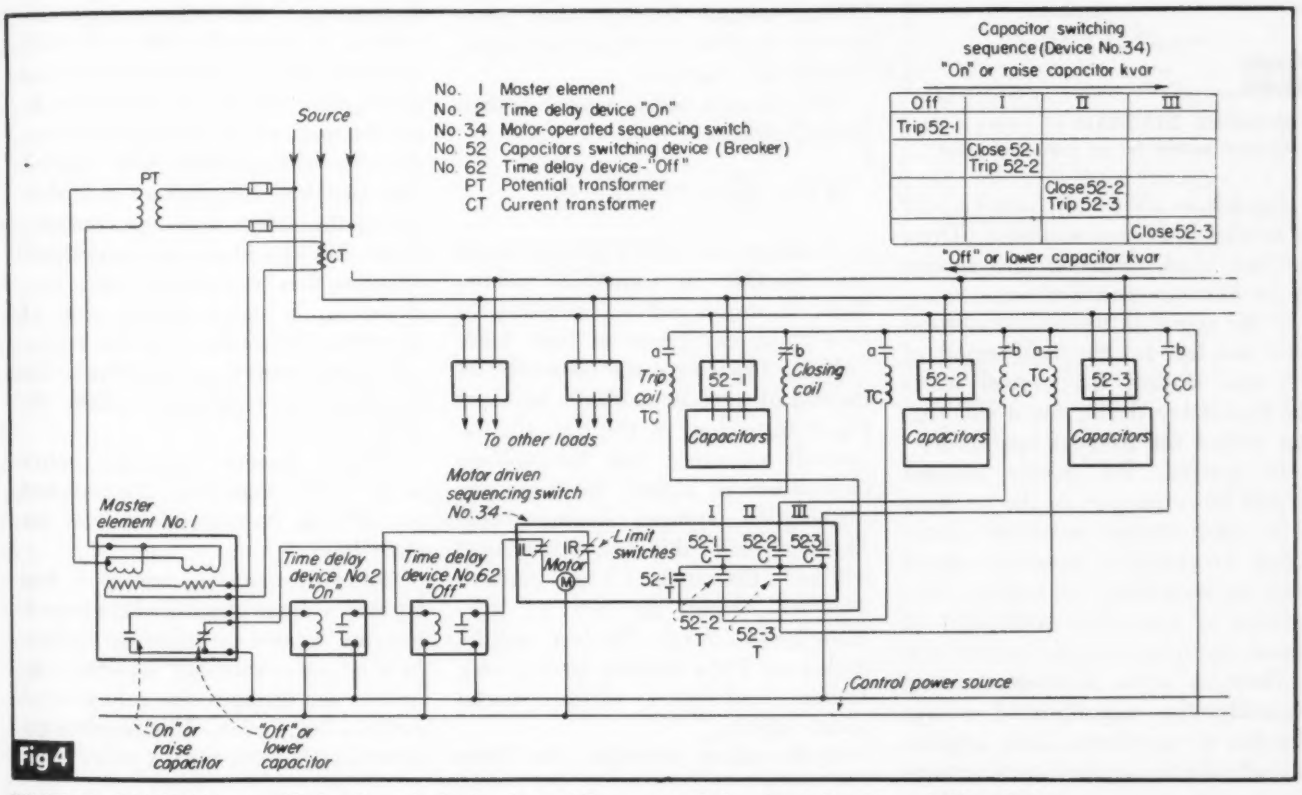


Fig 4

CONTROL DIAGRAM simplified schematically for 3-step kilovar control for circuit breaker switching devices

vars. It is usually an induction-type directional relay of the switchgear class. Two master elements are customarily used for a kilovar control to provide adjustment of the band width.

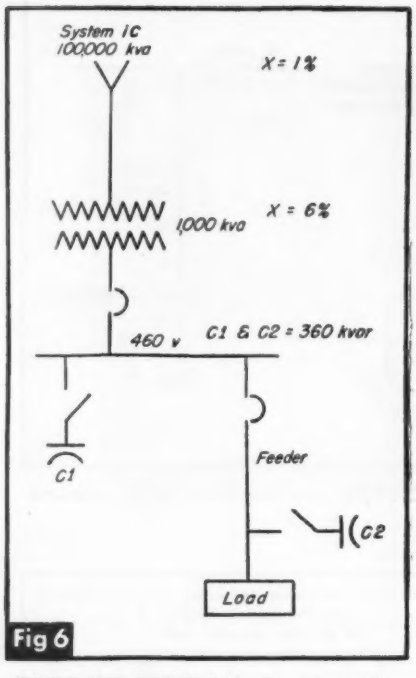
Two characteristics of these master elements should be understood to properly select and use the control. These are the "range of adjustment" and "band width."

The "range of adjustment" refers to the limits within which the master element may be set to operate. Some adjustment is necessary to allow for differences in operating conditions.

"Band width" is defined as the difference between pick-up (switching a capacitor off). The band width must be larger than the change in signal caused by switching the largest block of capacitors to prevent pumping action of the control. Normally, the band width is 20 to 35 percent larger than the change in signal due to switching a capacitor block.

Functional schematic diagrams are shown in Fig 3 and 4 for the two controls illustrated. The devices are shown in their deenergized positions in accordance with accepted practice.

Operational sequence of the kilovar control is as follows: As the load kilovars reach a predetermined value corresponding to the ON setting of the master element, the master element starts the time-delay device and establishes a closing circuit for the proper direction of the sequencing switch. After the time-delay, the sequencing device is started. This closes a set of contacts energizing the first capacitor switching unit. The same procedure is followed for succeeding steps. When load kilovars are decreasing the operation is similar.



ONE-LINE DIAGRAM of power distribution system for an industrial plant

Capacitors are usually switched out of service in reverse sequence. Thus, the last block switched into service is the first one switched out.

If the signal to the master element does not last for the full period of the time setting, the control resets the time-delay device for a full timing period for its next operation.

In general, the master element should be responsive to the quantity to be controlled or regulated. Table I lists the preferred types of controls used in switching capacitors. The location of capacitors and point of signal measurement is shown in Fig 5.

There is some misunderstanding regarding the magnitude of voltage rise due to capacitors. Each application should be checked to determine if automatic switching is required. A simple rule for this is as follows: The voltage change due to switching a capacitor is approximately equal to the capacitor current multiplied by the reactance (I_cX).

A representative layout for an industrial plant is shown in Fig 6.

The voltage change can be calculated from actual amperes and ohms or by the percent method. The percent method is simpler, and is expressed in the formula:

$$\%\ V_c = \frac{\text{Ckvar}}{\text{Base kva}} (\%X_b)$$

Where

$\%\ V_c$ = Approximate percent voltage change due to switching capacitors.

Ckvar = Kilovar rating of the capacitor to be switched.

Base kva = Kva selected for base (usually the transformer rating).

$\%\ X_b$ = Percent reactance of equipment on the selected base kva. (For transformers, the reactance can be assumed as the percent impedance given on the transformer nameplate. If this is not available, assume the reactance is 6 percent).

Assume that a 360-kvar bank, standard rating, is located at C_1 and is switched in one step. The equivalent system reactance can be calculated from the system short-circuit duty. When the system duty is not known, assume its equivalent reactance is equal to 1 to 2 percent on the transformer base kva.

These known values are substituted in the formula:

$$\%\ V_c = \frac{360}{1000} \times (1 + 6) = 2.5$$

A voltage rise of 2.5 percent is not objectionable in industrial plants. Thus, it would not be necessary to switch the capacitors at light load.

If the capacitors are connected at the end of a feeder as shown by C_2 of Fig 6 instead of at the bus, C_1, the over-all reactance and the voltage change will be higher. With modern distribution systems having cable feeder circuits, this added reactance will be in the range of 1 to 2 percent. This will change the value of $\%V_c$ from 2.5 to 2.9-3.2. The $\%V_c$ will be higher on 230-v systems having long feeders and open wiring spaced widely apart.

In the above example, the "light load" voltage with capacitors would be only 2.5 percent higher than without capacitors. If the light-load voltage is approaching the maximum, usually 10 percent higher than nameplate voltage rating of the devices used, the voltage level can be lowered by changing transformer taps. Automatic switching is necessary if the transformer is already on its highest tap.

In most industrial applications involving single-step capacitor switching, a current-responsive control is better than a voltage-responsive control.

This is because the operation of a current-responsive control is practically independent of system voltage fluctuations. If voltage-responsive control is used, the ON and OFF settings must be wide enough to avoid unnecessary operation caused by voltage fluctuations in the supply source. Also, a voltage-responsive control may switch the capacitors independent of the actual load requirements. Thus, the capacitors may be switched off when they are needed most. Furthermore, in some plants, most of the voltage variation is in the incoming supply source and not due to the variation or regulation within the plant.

When a current-responsive control is used, the capacitors are switched on and off in accordance with the plant load.

Current-responsive control is better than voltage control where capacitors are located on adjacent feeders. In this case, switching capacitors on one feeder changes the voltage level on the other feeder. This requires the band width setting of a voltage re-

TABLE I—Selection of Automatic Control Equipment

Item	Purpose	Voltage Conditions	Preferred Control	Location of Capacitors and Point of Signal Measurement* (See Fig 5a)	(See Fig 5b)
1	Remove capacitors at light load	V_B Constant	Voltage—multistep		C or UC
			Voltage—single-step		C or UC
			kvar—multistep	C	C
			kvar—single-step	C or UC	C or UC
			current—single-step	UC	UC
	Note: Current control applicable when power factor is reasonably constant with load variation.				
2	Remove capacitors at light load	V_B Variable	kilovar—multistep	C	C
			kilovar—single-step	C or UC	C or UC
			current—single-step	UC	UC
3	Remove capacitors at light load	V_B Variable due to switching capacitors on adjacent feeders	kilovar—multistep		C
			kilovar—single-step		C or UC
			current—single-step		UC
4	Regulate Feeder Voltage	Bus voltage reasonably constant	voltage—multistep		C
5	Regulate kilovars	Not important	kvar—multistep	C	C
6	Regulate power factor	Not imporatnt	kvar—multistep (See text for explanation)	C	C

* "C" refers to corrected load measurement—i.e., with effect of capacitors included. "UC" refers to uncorrected load measurement.

sponsive master element to be much wider than desirable.

If the load pattern and power factor are fairly uniform, a current control is satisfactory. If these change abruptly and are unpredictable, then a kilovar-responsive control is better.

Single-step current and kilovar-responsive controls have the same general application. But the current control is generally used for cost reasons; it requires only a current transformer for signal indication.

A current-responsive control is generally used for single-step application. However, a kilovar-responsive control is used for multi-step switching. Load patterns show that multi-step current control is unsuitable. This is because of the many switching operations caused by the hunting action between master elements. But even in cases where this hunting is avoided, the over-all performance is poorer than with a multi-step kilovar control. Thus the current-responsive control is limited to single-step application.

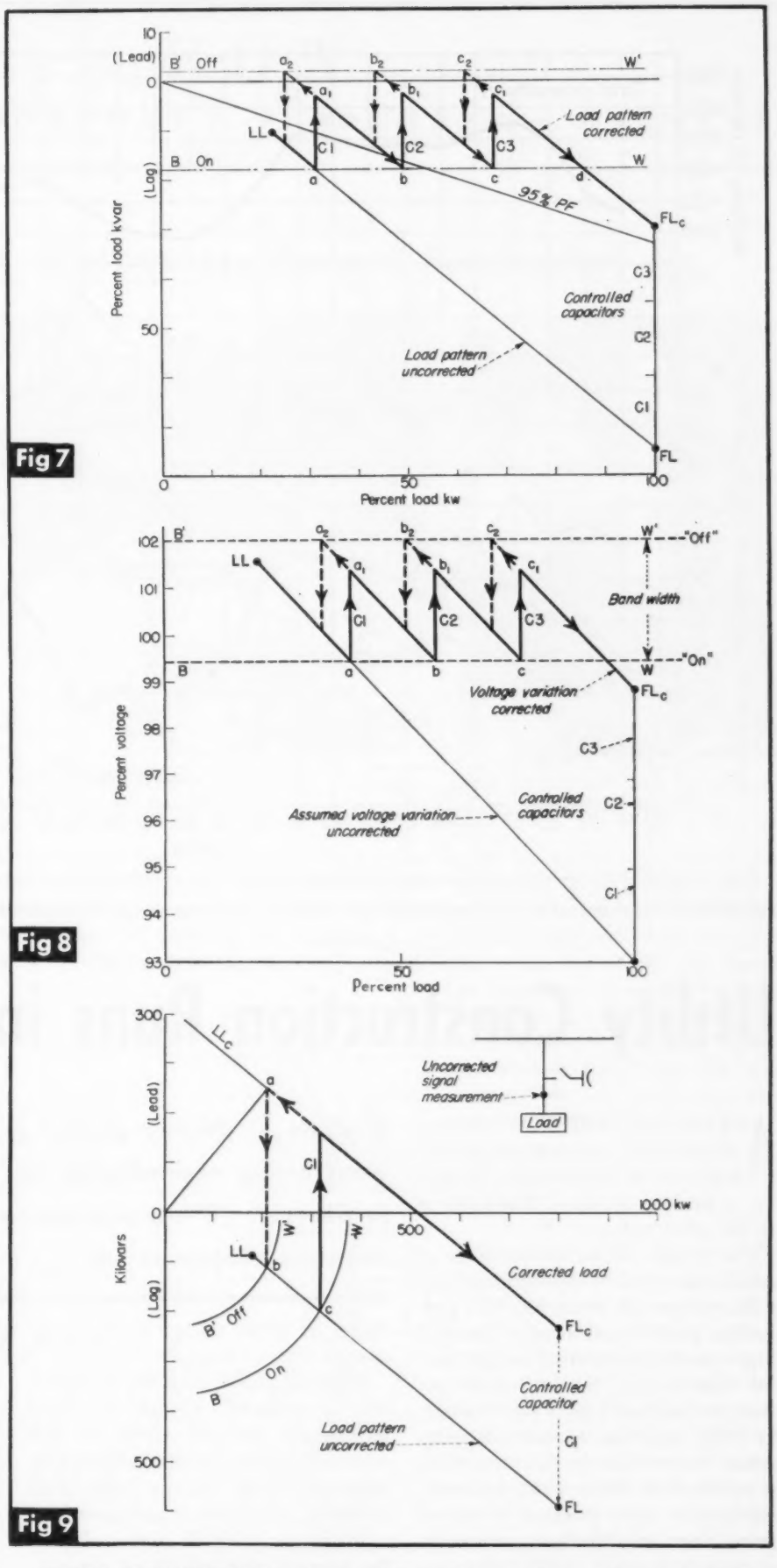
If capacitors are applied for rate purposes only, and there is no voltage rise or loss at light load, it is not necessary to switch unless there is a penalty for leading power factor.

But where power factor is determined on an average monthly basis or from readings of integrated kilowatthours and kilovarhours, it is advantageous to leave the capacitors permanently connected.

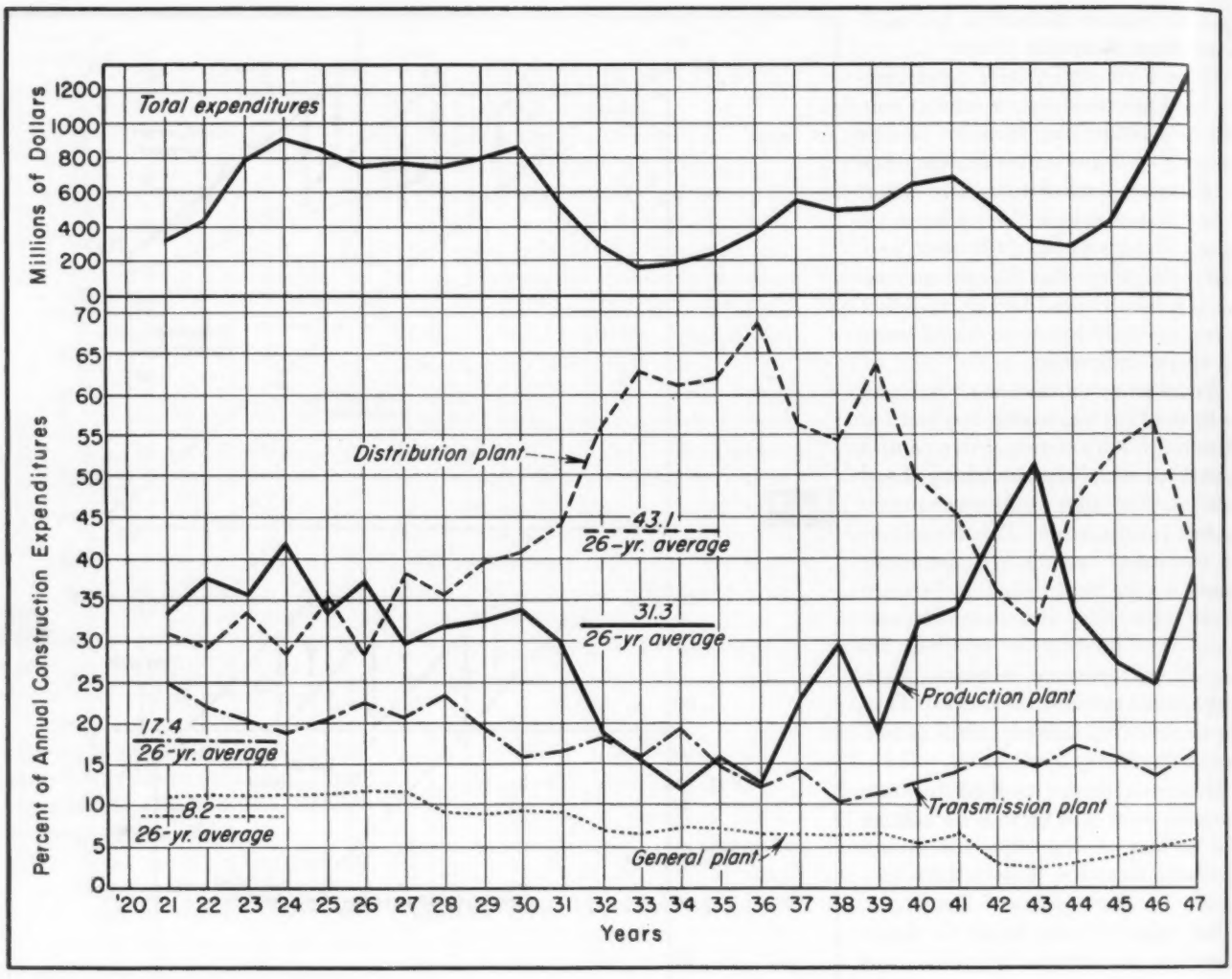
If it is desired to have the capacitors on at heavy loads for rate reasons, but off at light load to minimize voltage rise or losses, a kilovar- or current-responsive master element provides the most direct solution. Unless multi-step switching and control to regulate voltage or to keep the losses at a minimum can be justified, a single-step control, judiciously set, will usually be sufficient.

Load diagrams show the effect of automatically switching capacitors. They also show the effect of the size and number of steps to be switched, and location of the band width.

Load diagrams can be plotted with actual values of kw, kvar, etc., or in percent values. Diagrams for kilovar and voltage controls are usually plotted in percent values; actual values of kw and kvar are used for current control. Typical load diagrams for kilovar, voltage, and current controls are shown in Fig 7, 8 and 9.



TYPICAL LOAD DIAGRAMS (7, 8, and 9) for kilovar, voltage, and current controls. Diagrams for kilovar and voltage controls are usually plotted in percent values. Actual values of kw and kvar are used for current control



PROPORTIONS of annual construction expenditures taken by four major construction classifications

Utility Construction Runs in Rhythm

Analysis of 26-year period reveals rhythmic variations in construction expenditures for production and distribution facilities . . . When production plant expenditures rise, distribution allotments fall . . . and vice-versa

ALTERNATE SHIFTING of emphasis from production to distribution is characteristic of electric utility construction. When one is up the other is down.

The graph shows proportions of annual construction expenditures over a 26-year period. Prior to 1927, production plant construction claimed a larger piece of the annual budget than did distribution. Then distribution took the lead and kept it for 15 years. In 1942, war-time capacity requirements restored the larger proportion to production. Since 1943, however, distribution has asserted a larger claim. Even with the heavy emphasis on capacity increase in 1947, distribution still takes the biggest piece. But it is considerably smaller than its share in 1946. Later figures may change this condition.

Production and distribution maintain a constant rhythm of complementary ups and downs. In this relationship, they are little affected by expenditures for the two other plant elements, transmission and general.

In the period 1921-1946 inclusive, the average proportions of expenditures in these four plant accounts were: Distribution 43.1 percent; production 31.3 percent; Transmission 17.4 percent; and General 8.2 percent.

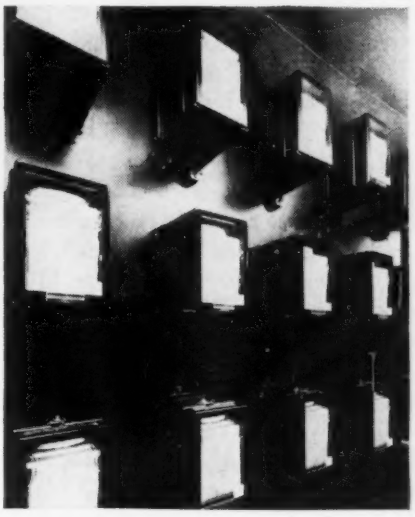
Present indications are that distribution will continue to demand the largest share of construction dollars. In the next few years, however, production may counter this trend. But whatever happens, it is fairly certain that as budget proportions for production rise, proportions for distribution will fall, and vice-versa.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Graphic Wattmeters Record Production

POLISHING MACHINES that process stainless steel sheet are monitored by graphic wattmeters that record operations of each machine throughout the day



GRAPHIC WATTMETERS connected to polishing machines are located in the office

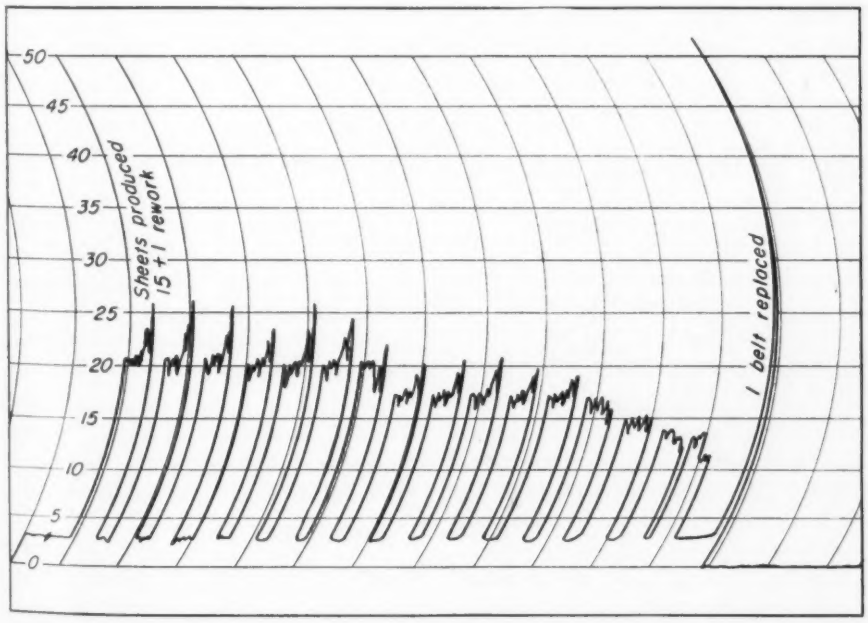
RECORDING WATTMETERS "double in brass" in the polishing department of the Eastern Stainless Steel Corp, Baltimore. The meters are connected to individual sheet polishing machines and located in the department office. They help foremen control the loading of machines and provide vital production control information.

The company's polishing department has grown rapidly. The job-reporting of operations and counting of production units for inventory and payroll purposes has also grown. Since the department works under an incentive bonus plan, a premium is put on exact, dependable records.

Several ways of getting this information have been tried. All failed in varying degrees until the graphic wattmeters were installed. These were the answer to load control, production control and scheduling problems within the department.

The meters, some of which are shown, record the load in kilowatts on the motor driving each polishing machine. Each meter draws a chart of load vs time on a tape moving 12 in. per hr. This tape lasts nine 8-hr shifts. After each shift the tape is cut, marked with the machine number, date and shift. At this point, it is turned over to production for analysis.

Since motor speed of the polishing machines is constant and operations follow an established pattern, an accurate count of sheets polished can be obtained from the wattmeter strip charts. But that isn't all. The chart's



WATTMETER CHARTS tell the story. The number of cycles on the chart is the number of sheets produced. The wattage, which indicates polishing pressure, is an indication of work quality. Note delay for belt replacement

pattern also shows clearly how many abrasive belts were used and the elapsed machine time—including productive and delay time—on each job. The charts also tell the foremen whether sheets have had the correct number of passes and whether maximum output of the motor is being obtained without danger of overload.

For this operation, graphic wattmeters serve several vital production functions.

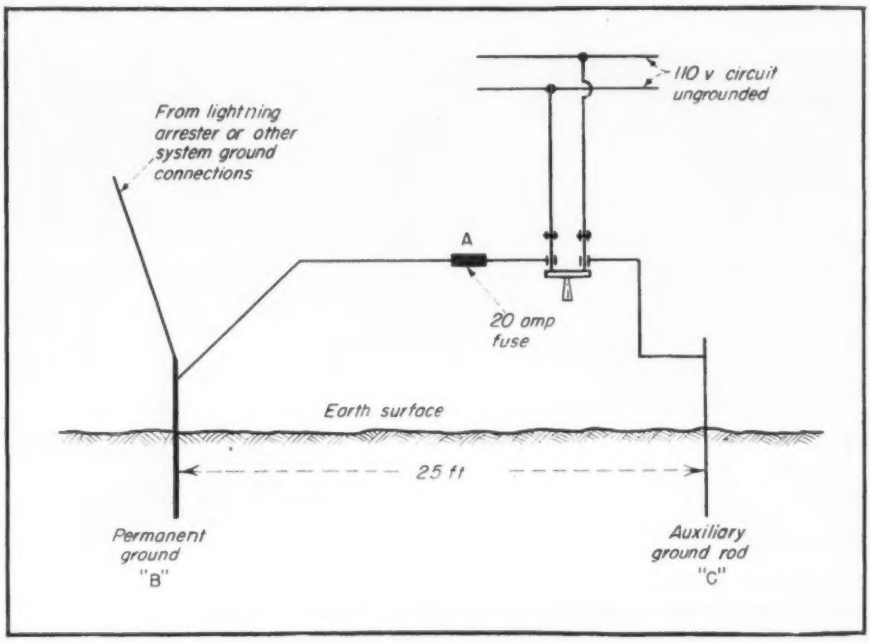
• • •

How to Check Grounds with a 20-Amp Fuse

To PROTECT industrial power systems against lightning damage, insurance engineers recommend keeping ground resistance under 5 ohms. They offer the following method of checking ground resistance value:—

1. Drive an auxiliary ground 25 ft from the connection being tested.
2. Connect a double-pole switch to an undergrounded 110-v circuit.
3. Connect one side of the 110-v circuit to the auxiliary rod through a 20-amp fuse.
4. Connect the other side to the ground being tested.
5. Close the switch. If the fuse blows, the sum of the resistances of the two grounds is less than 5 ohms. This means the ground under test is satisfactory.

If fuse fails to blow, the resistance is probably too high. An exact instrument check is then needed.



CONNECTIONS for checking ground resistance with a 20-amp fuse. If fuse A blows, sum of resistances B and C is under 5 ohms. If fuse doesn't blow, make an accurate instrument check

Water mains with lead joints are claimed to make the best grounds. Use of ground clamps or brass plug connectors is recommended. If plates or rods are corroded and water pipes aren't handy, new plates should be buried below moisture level. But if the plates, although in good shape, still show high resistance, other plates should be buried at least 6 ft apart and connected by a heavy wire. Grounds on chimney lightning rods should be tested thoroughly at least once every year.

• • •

Use of Damper Windings on A-C Generators

VII*—POWER PULSATION (cont'd)

WILLIAM L. RINGLAND
Electrical Engineer
Allis-Chalmers Mfg Co
Milwaukee, Wis.

A MORE COMMON PROBLEM arises for the case of a single diesel-engine-driven generator operating in parallel with what may be idealized as an infinite system. The synchronizing power of the generator and the flywheel effect of the unit result in the unit having a certain natural frequency of oscillation when connected to the system. The amount of electrical power pulsation resulting from a given amount of engine torque pulsation depends upon the ratio of the impressed frequency to this natural frequency. At very low ratios, the electrical pulsation is very nearly equal to the torque pulsation. As the ratio is increased, the electrical pulsation is amplified until at resonance, when the ratio is unity, the electrical pulsation is limited only by damping. For a machine without a damper winding, the peak amplification factor might be about 60, while dampers might reduce it to about 15. As the impressed frequency is increased beyond this point, the amplification factor rapidly decreases, reaching a value of 1.0 at a ratio of 1.41 for any amount of damping, and continuing to decrease at higher ratios with the effect of the amount of damping normally obtainable being entirely negligible but acting to increase the amplification factor.

The action of a damper winding in limiting the electrical pulsation at resonance might appear to be very valuable. However, in practice, any unit operating sufficiently close to resonance for damping to be a signifi-

* This series began in ELECTRICAL WORLD, August 16, 1947, page 81.

what's new in street lighting

UPSWEEP BRACKET *now available* for steel poles

The atrractive, new style G-E upsweep street-lighting bracket is now being made for steel poles—especially existing tubular trolley poles.

Basically the same as the upsweep bracket offered for wooden poles last year, it is attractive yet strictly utilitarian. It permits raising mounting heights of luminaires. The newly designed malleable-iron pole plate simplifies mounting and provides a 1 3/8-inch, large radius cable opening that makes wiring easier, and prevents cracking of insulation.

Cut-away drawing of malleable-iron pole plate, used with the new upsweep bracket, and showing large-angle cable entrance.

AVAILABLE IN ALL LENGTHS—FOR ALL POLE DIAMETERS
These brackets come in 4-, 6-, and 8-ft lengths; they will fit any steel pole from three to nine inches in diameter. The bracket arm, of 1 1/4-inch steel pipe, takes the modern side-mounting slip-fitter hood and is also available with threads for a right-angle joint and top-tapped hoods. Scroll is of 1 1/8 x 3/8-inch steel. All parts are heavily galvanized.

G.E. CAN FURNISH ANY TYPE OF BRACKET OR MAST ARM
Upsweep brackets are only one type in General Electric's full line of street-lighting brackets and mast arms for wood, steel, and concrete poles. Any type you require can be secured from General Electric. It will simplify your ordering to get brackets along with your luminaires—from your nearest G-E office.

GOOD STREET LIGHTING BUILDS GOOD WILL
The new line of brackets is another of many developments which General Electric has pioneered to help you provide better street lighting at less cost. For additional information call our nearest office or write to *Apparatus Dept., General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC

452-57

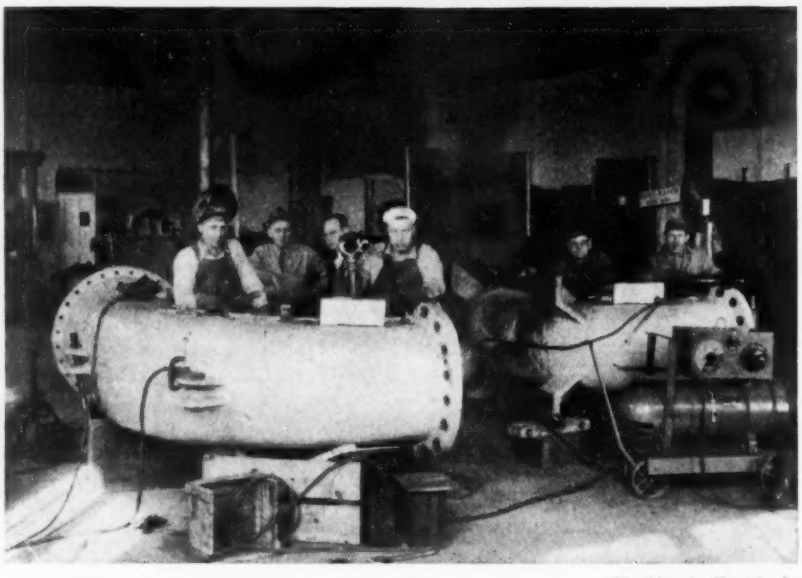
Are you tying in with the NEMA plan to give America better street lighting?

cant factor would be very likely to have more pulsation than could be tolerated. The usual practice is to supply flywheel effect to give a natural frequency at least 20 percent lower or 25 percent higher than the impressed frequency. For these conditions, the undamped amplification factor is about 2.5 and the maximum effect of a damper winding would be unlikely to reduce this figure by more than 5 percent.

Two generators in parallel have a single natural frequency of oscillation against each other somewhere between their individual natural frequencies on an infinite system. Resonance of this natural frequency under any load conditions with either of the two impressed frequencies must usually be avoided by the same margin as was mentioned for the single generator on an infinite system, and the effect of damping is of a similar and insignificant magnitude.

The problem of securing satisfactory parallel operation of a greater number of engine-driven generators can be very complex. Various natural frequencies result from different modes of oscillation. These natural frequencies must generally be set by means of proper flywheels to avoid resonance with any of the various impressed frequencies by a sufficient margin.

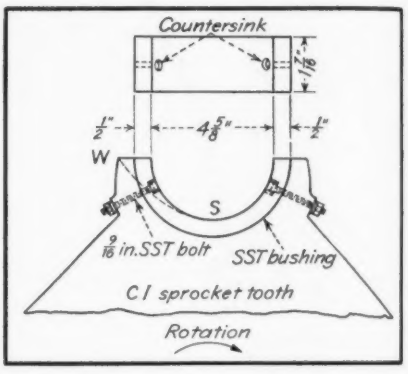
Worn Sand Pump Repaired By Welding



The Lincoln Electric Co

NINE-YEAR EROSION of a 1,280-hp sand pump at the Loup River Public Power District's Columbus plant was repaired by shielded-arc welding. Round manganese applicator bars (½- and ¾-in.) were welded to inner circumference of bowls. Deposits were made in intermittent 2 x 8-in. blocks. Stainweld A-5 austenitic electrodes were used because peening hardens the surface but leaves the metal soft and tough. About 1,000 lb were required along with 1,200 man-hours to repair the two 9-ft 7-in. half sections that constitute the bowl, reduced in thickness in places from 3 to 2 in. by the sand.

Stainless Steel Bushings Maintain Sprocket's Pitch



BUSHING of stainless steel provides a harder bearing surface for roller chain, thus avoiding wear in the direction indicated by dotted line SW, and can be renewed

E. E. LAMBERSON
Superintendent of Production
Staten Island Edison Corp
St. George, S. I., N. Y.

SEA WATER from the Kill Van Kull is used in the condensers of Staten Island Edison's Livingston generating station.

Stainless steel bushings and rollers have minimized wear on sprocket surfaces carrying roller chains and baskets for condensing water screens.

The 30-in. diam sprocket is ordinarily cast iron. On its perimeter, the roller chain rides in a series of recesses which have been fitted with 18-8 stainless steel half-bushings. Each half-bushing has dimensions as shown and is fastened by two $\frac{9}{16}$-in. diam stainless steel bolts with heads countersunk. There are five bushings on each sprocket and two sprockets on each of the two screens. Rollers of 18-8 stainless steel instead of cast iron are used on the roller chain.

SUBSTATIONS

with your load

The new package substations give a valuable flexibility to operators who must supply today's growing loads and prepare for tomorrow's.

This flexibility—illustrated at the left—is achieved by forward-looking designs that provide substation capacity in easily installed, easily moved "blocks of power." It enables you to:

1. **Be ready for expected—or unexpected—load growth or load shifts.**

Addition or re-location of package substation capacity is quick, easy and economical. There is no costly modification or rearrangement of installed equipment. The same flexibility enables you to remove capacity just as readily, to follow a shifting load.

2. **Reduce your system investment by more closely matching your installed substation capacity with changing loads.**

Cost comparisons and operating experience show that the "building block approach" of the new package substations can materially lower your system costs. Easy, economical installation of relatively small "blocks of power" enable you to make your installed substation capacity follow your load in small economical steps (right).

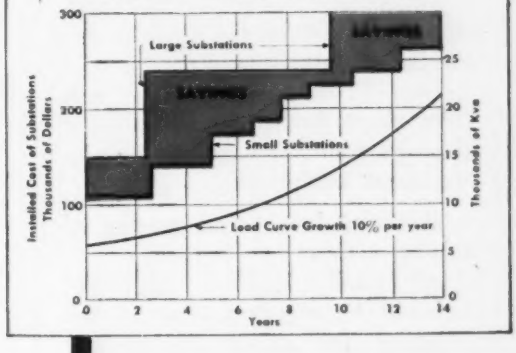
This on-the-job economy is but one of the package substation savings. Because you can select a *complete* substation as a unit, you save weeks of costly detailed planning right at the start. You go directly from the job to be done to the complete substation for the job. You need prepare but *one specification,* place but *one order.*

A helpful, 78-page bulletin, GEA-4500, describes 30 standard classes of package substations, gives you helpful application information on each, and shows just how each will look installed. If you do not have a copy, your General Electric sales representative will be glad to provide one, and work with you on any application you are considering. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

The chart below assumes an accurate load-growth prediction—which is seldom found in practice. If load growth is erratic, the savings will usually be even greater than shown.

The practice of meeting load growth with relatively small "blocks of power" also insures against excessive unused capacity in event of an unpredicted drop in load. Then, any unused capacity that has been added in small "blocks" can readily be moved to meet load growth in another area.

HOW YOU SAVE BY ADDING CAPACITY IN SMALL "BLOCKS OF POWER"



SAVINGS ON SUBSTATIONS

(Total annual charges at 12%)

Using large substation of fixed capacity.....	$434,000
Using package substations with "building block" approach.....	$330,000
Savings.....	$104,000

GENERAL ELECTRIC

321-54-5900

A Guide to Illumination From Various Lighting Units

Chart gives approximate illumination values in foot-candles on the horizontal working plane from various types of equipment based on watts per square foot . . . Actual illumination resulting depends on size of room, color of ceiling and walls and type of lighting equipment . . . Graph is distributed by Electricity Sales Dept of Commonwealth Edison Co to architects, consulting engineers and contractors in Chicago

Procedure in Designing Lighting Installation

1. Under type of work select foot-candles.

2. Select type of fixture.

3. Follow down line of foot-candles advocated to point of intersection with curve of fixture chosen. Read watts per square foot on vertical scale at left of graph.

4. Watts per square foot times area of room equals total wattage. From catalog or fixture specification, determine wattage of each fixture (including ballast watts if fluorescent).

5. Divide total wattage by rated wattage of fixture selected to determine number of fixtures needed.

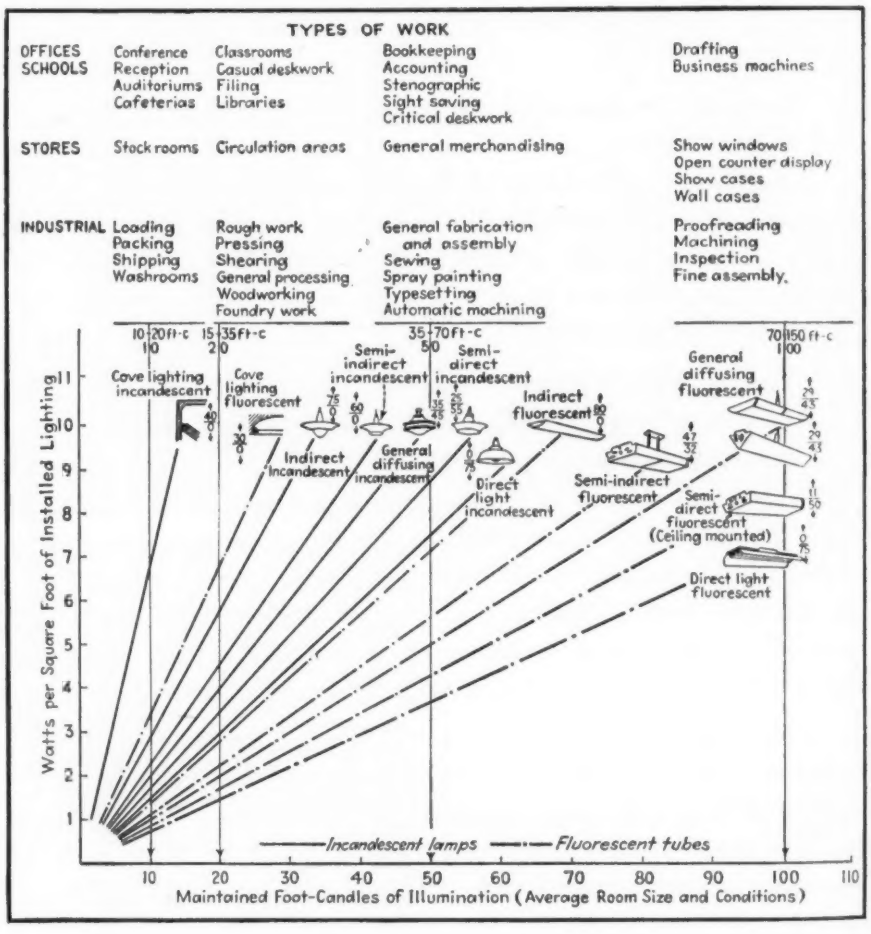
Note: — Fluorescent lighting provides about double the illumination given by a similar installation of incandescent equipment.

6. Mounting height and spacing of lighting outlets:

(a) Usually lighting equipment should be mounted close to the ceiling for direct lighting or suspended about ¼ distance from floor to ceiling for indirect lighting.

(b) Spacing of ceiling outlets for incandescent lighting, should be equal to the mounting height of lighting equipment above floor.

(c) In spacing ceiling outlets for fluorescent lighting, fixtures are often arranged in continuous or broken rows to provide even illumination. Distance between rows or fixtures should not exceed mounting height. Continuous rows of fixtures should usually run parallel to the normal direction of occupants' line of sight. An exception is the shielded "direct-light" types which are often run crosswise to view.



7. Additional information:

(a) Decorative Lighting Outlets. Lighting to produce special effects in theaters, auditoriums, and homes requires individual consideration.

(b) Display Windows. (Incandescent lighting)

Main shopping districts—200 or more w per lineal foot. For outlying districts—150 w per lineal foot.

"Deep windows" require more wattage.

(c) Signs—Wiring capacity minimum, 1,500 w per store. Chicago Electric Code, 1938.

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8-1-47

Sag-Tension Data For Aluminum Cable

Initial and final sag and tension values for stringing No. 2 and No. 1/0 hard-drawn stranded aluminum conductors, bare and triple-braid weatherproof, at various loadings in nominal span lengths 100 to 200 ft . . . Data supplied by Aluminum Co of America, Pittsburgh, Pa.

Loading			Span, ft → 100				125				150				175				200			
			Final		Initial		Final		Initial		Final		Initial		Final		Initial		Final		Initial	
Temp, F	Ice, in.	Wind, lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb	Sag, ft	Tens., lb
No. 2 Aluminum Cable, Bare																						
0	1/2	8	1.87	662	....	...	2.75	702	....	...	3.95	702	....	...	5.40	702	....	...	7.10	702	....	...
32	1/2	0	1.70	402	....	...	2.55	425	....	...	3.75	419	....	...	5.20	408	....	...	6.85	404	....	...
−20	0	0	0.22	354	0.15	527	0.60	205	0.24	512	1.70	104	0.49	352	3.25	73	1.60	149	5.10	61	3.25	97
0	0	0	0.33	234	0.16	467	0.95	125	0.28	442	2.15	78	0.62	282	3.70	64	1.90	125	5.50	56	3.65	84
32	0	0	0.68	115	0.22	360	1.45	84	0.38	325	2.80	63	0.95	180	4.20	56	2.45	97	6.00	52	4.35	72
60	0	0	1.23	63	0.31	255	1.95	62	0.60	200	3.25	54	1.50	116	4.70	50	2.95	80	6.40	49	4.85	64
90	0	0	1.65	47	0.52	156	2.40	50	1.00	121	3.70	47	2.10	83	5.10	47	3.50	68	6.80	46	5.40	58
120	0	0	2.08	37	0.85	86	2.85	43	1.40	86	4.10	43	2.75	64	5.50	43	4.20	57	7.20	43	5.90	53
No. 1/0 Aluminum Cable, Bare																						
0	1/2	8	1.47	936	....	...	2.16	1000	....	...	3.00	1035	....	...	4.10	1035	....	...	5.35	1035	....	...
32	1/2	0	1.36	580	....	...	1.98	620	....	...	2.80	634	....	...	3.85	630	....	...	5.10	618	....	...
−20	0	0	0.18	708	0.15	808	0.31	625	0.24	808	0.59	473	0.39	720	1.50	251	0.73	520	2.75	178	1.47	336
0	0	0	0.24	526	0.18	690	0.43	445	0.28	690	0.86	323	0.46	600	1.87	200	0.94	400	3.25	152	1.92	257
32	0	0	0.48	257	0.26	472	0.87	220	0.40	475	1.57	176	0.71	390	2.55	148	1.55	244	3.80	130	2.80	176
60	0	0	0.95	128	0.43	282	1.45	133	0.69	280	2.20	126	1.18	235	3.25	116	2.15	175	4.55	108	3.45	143
90	0	0	1.45	85	0.85	145	2.00	96	1.25	154	2.82	98	1.83	152	3.85	98	2.82	134	5.10	97	4.10	120
120	0	0	1.85	66	1.30	95	2.50	77	1.75	110	3.30	84	2.42	115	4.40	86	3.50	108	5.75	86	4.75	104
No. 2 Aluminum Cable, TBWP																						
0	1/2	8	2.40	633	....	..	3.70	633	....	...	5.40	633	....	...	7.35	633	....	...	9.65	633	....	...
32	1/2	0	2.30	380	....	...	3.60	380	....	...	5.30	380	....	...	7.25	377	....	...	9.55	375	....	...
−20	0	0	1.00	141	0.65	219	2.35	94	2.00	110	4.10	77	3.75	84	6.10	71	5.75	75	8.45	67	8.10	69
0	0	0	1.30	108	0.95	151	2.65	83	2.25	98	4.35	73	4.00	79	6.35	68	6.05	71	8.70	65	8.40	67
32	0	0	1.70	83	1.40	101	3.00	74	2.70	82	4.70	67	4.40	72	6.65	65	6.40	68	9.00	63	8.70	65
60	0	0	2.05	68	1.75	81	3.35	66	3.05	72	5.05	63	4.75	67	7.00	62	6.75	64	9.30	61	9.00	63
90	0	0	2.35	60	2.10	68	3.65	60	3.35	66	5.35	59	5.05	63	7.30	59	7.00	62	9.60	59	9.35	60
120	0	0	2.60	54	2.40	59	3.90	56	3.65	60	5.65	56	5.35	59	7.60	57	7.30	59	9.90	56	9.65	58
No. 1/0 Aluminum Cable, TBWP																						
0	1/2	8	1.80	932	....	...	2.80	932	....	...	4.05	932	....	...	5.55	932	....	...	7.20	932	....	...
32	1/2	0	1.75	590	....	...	2.75	590	....	...	4.00	590	....	...	5.50	585	....	...	7.15	580	....	...
−20	0	0	0.45	500	0.35	635	1.25	274	1.00	340	2.45	207	2.05	240	3.90	171	3.50	190	5.65	153	5.30	163
0	0	0	0.60	350	0.45	500	1.60	213	1.30	262	2.80	174	2.40	204	4.30	156	3.90	171	6.00	145	5.65	154
32	0	0	1.05	206	0.75	290	2.05	166	1.75	195	3.30	149	3.00	164	4.75	140	4.50	149	6.45	135	6.15	142
60	0	0	1.45	148	1.20	185	2.45	139	2.20	156	3.70	132	3.40	144	5.20	129	4.90	137	6.85	127	6.50	134
90	0	0	1.85	117	1.60	135	2.85	120	2.60	131	4.10	119	3.80	128	5.60	119	5.30	127	7.25	120	6.95	125
120	0	0	2.20	100	1.95	110	3.20	107	3.00	114	4.45	110	4.20	116	5.95	112	5.70	117	7.60	115	7.35	118

Physical Characteristics of Aluminum Cable, Hard Drawn

	No. 2 Bare	No. 1/0 Bare	No. 2 TBWP	No. 1/0 TBWP
Weight per 1,000 ft	62.0 lb	98.5 lb	112.7 lb	174.5 lb
Rated Strength	1405 lb	2070 lb	1265 lb	1863 lb
Diameter	0.292 in.	0.368 in.	0.460 in.	0.570 in.

Calculations based on following limiting conditions:

1. 50% of rated strength with 1/2-in. ice, 8-lb/sq ft wind, at zero F
2. Initial tension with no ice or wind at zero F not to exceed 1/3 of rated strength.
3. Final tension with no ice or wind at zero F not to exceed 1/4 of rated strength.

These tables are supplementary to engineering data published in ELECTRICAL WORLD, September 13, 1947, pages 103 to 119.

Housekeeper's Pet!

It's brightening the smiles of housekeepers these days—and the smiles of the retailers and manufacturers who supply them.

It's this electrical cord that *looks* new, *stays* looking new, and wipes clean and bright with the whisk of a cloth—*modern* appliance-wire insulated with smooth, sleek, colorful VINYLITE Brand Plastics. There's no braiding or other covering material to catch grease and grime.

It comes in virtually any color you choose for your product... gay colors for kitchens, playrooms, or sun porches... pastel shades for living rooms and bedrooms... a joy to the decorator's eye. The plug is *molded* from VINYLITE Plastic as an integral part of the *extruded* VINYLITE Plastic insulation—and is well-nigh indestructible!

Such wiring spruces up any manufacturer's appliances—and gives undreamed-of service, thanks to the remarkable properties of VINYLITE Plastic insulation. It does not kink. It resists abuse as no appliance wire has ever done before. It is *non-aging*—some types are non-flammable, others burn very slowly. And it resists moisture, acids, oils and most chemicals as well as abrasion.

Make *your* electrical appliance a "housekeeper's pet." Write Department CD-28, and ask for a technical representative (available to industrial organizations) to call and discuss your wire and cable problems.

VINYLITE

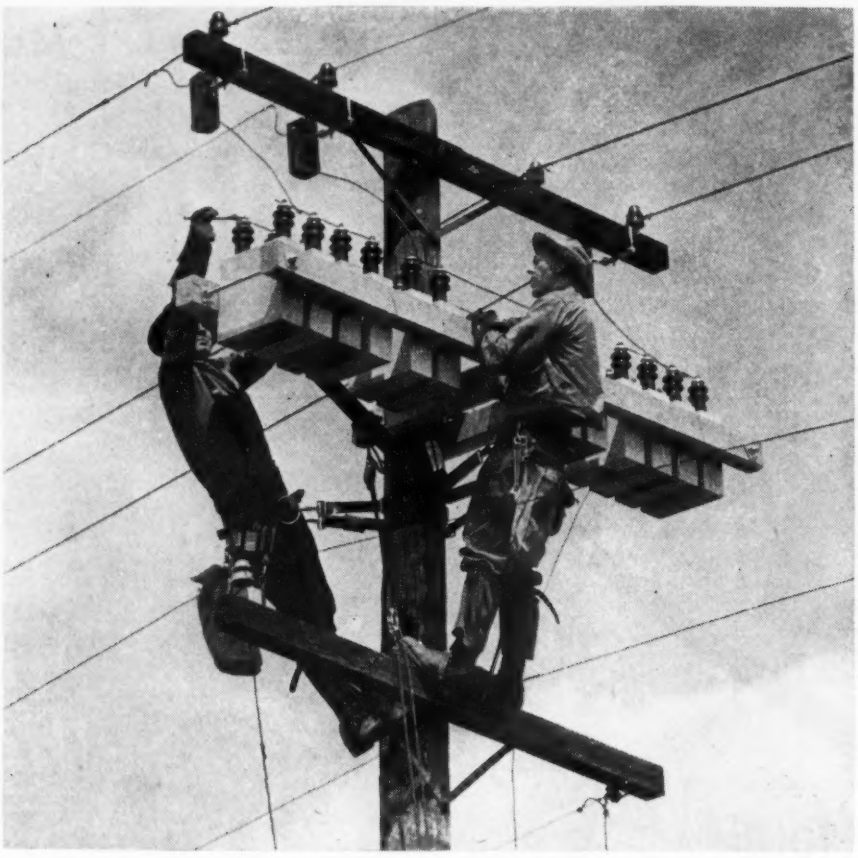
TRADE—MARK

PLASTICS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.

Capacitors Between Double Arms—No Hanger Irons

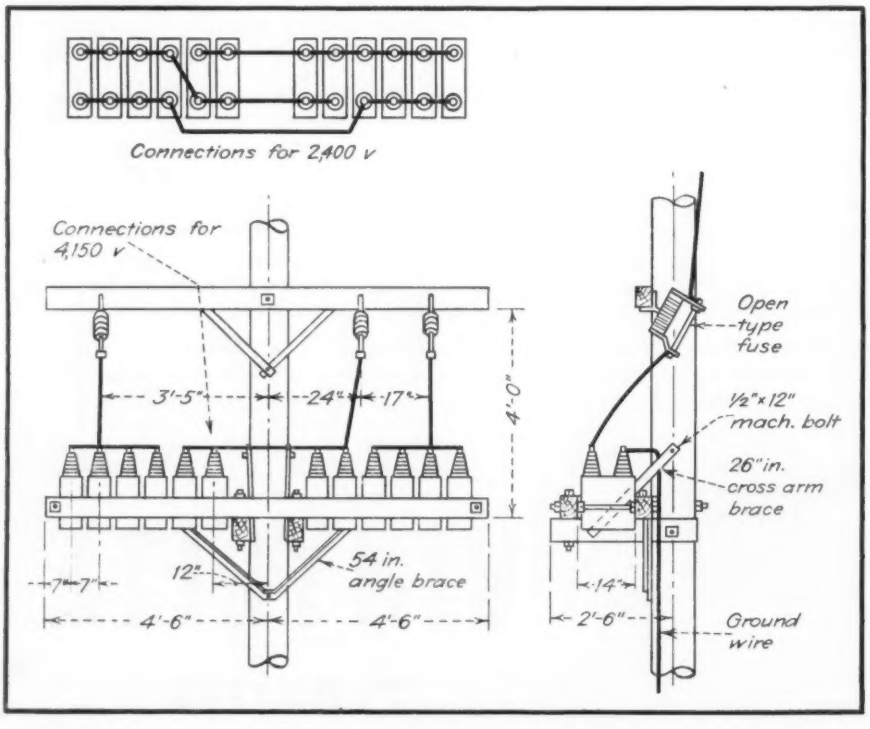
EARL BAUGHN
Washington Water Power Co
Spokane, Wash.



SIMPLE CAPACITOR MOUNTING makes neat and substantial installation without use of hanger irons (cutouts contained no fuse lines and bank was dead at the time this picture was taken)

A SIMPLE and inexpensive method for pole mounting of capacitors in banks of 180 kva has been developed. There appeared to be no advantage in the conventional iron hanger bracket method of mounting, so the Washington Water Power Co standardized on a single set of double arms bracketed out from one side of the pole. The arms are so spaced that the capacitor units simply sit down between them on their mounting brackets or flanges. This is a much less expensive mounting method.

Twelve units, six on each side of the pole, totaling 130 kv, are mounted in this manner. Installations of this kind are distributed around over 4-kv feeders. They will comprise a large part of the 40,000 kva in capacitors that the Washington Water Power Co will install this year.



METHOD of mounting capacitors between double arms bracketed out from one side of pole. Crossarms (9 ft) are inverted to provide flat surface at top; capacitors fastened by 10d nails left projecting ½ in. Capacitors rest on No. 6 soft-drawn copper wire stapled along edge of each arm; the wire is connected to common neutral and to ground

Proper Connection of Open Wye–Open Delta Transformers

L. M. HOOK
Pacific Gas and Electric Co
Oakland, Calif.

IN SUPPLYING both light and power loads from transformers of dissimilar size there is a correct way to connect them in open wye-open delta for best results. Experience has shown performance of such a bank to be better when the larger transformer (supplying single-phase lighting load) is connected to the lagging phase, which has a higher voltage due to unbalance of the open-delta connection under load.

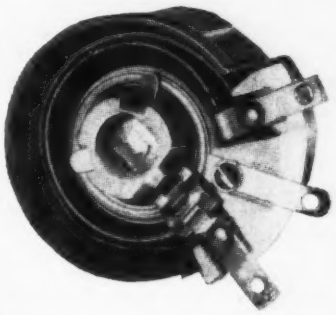
To establish the proper connections for an installation of this type it is necessary to know phase rotation. Phase marking on a system is usually arbitrarily established by the utility involved; phase sequence (or rotation) is determined by rotation of the generators. Although standards

Factors in Insulation Selection

MICA INSULATOR PRODUCTS MEET EXACTING DEMANDS

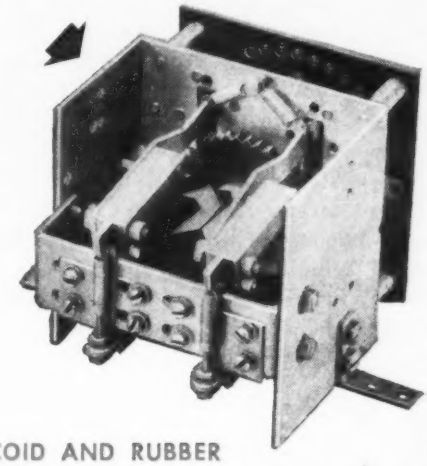
LAMICOID

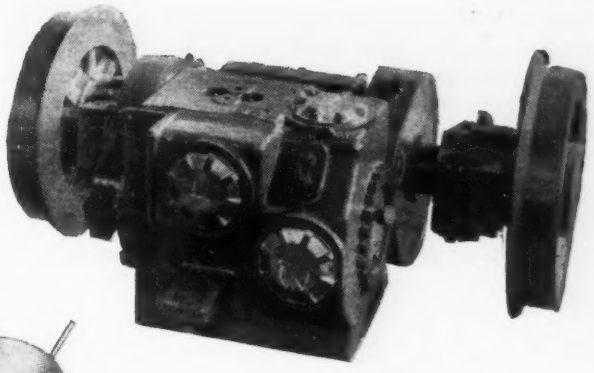
—a thermosetting laminated plastic, provides low dielectric losses, assures high operating efficiency when used for contact spacers, coil ends and ratchet gears on such products as this adding and subtracting relay. Lamicoid has unusually low moisture absorption—changes little even when exposed to high humidity over long periods.



MICANITE TUBING

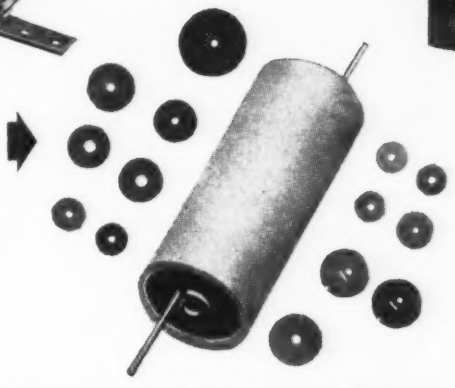
—mica films bonded with quality resins—was slit and inserted between the resistance element and metal case of this metallic rheostat. Specifications called for a thin, flexible material that would provide complete electrical insulation and be capable of withstanding temperatures up to 300°F.





LAMICOID AND RUBBER

team up to provide rare combination of properties. Millions of "can-type" electrolytic condensers are sealed by washers of Lamicoid bonded to natural or synthetic rubber. This use is only one of many interesting applications where Lamicoid's good dielectric properties, mechanical strength and resistance to chemical corrosion combine with the properties of rubber for better product performance and dependability.



MICA

insulation between commutator segments and Micanite wrappers on pre-insulated coils protect this mine locomotive motor from dampness, condensation and high temperatures encountered in service.

More than 50 years' experience in all types of insulation materials enables Mica Insulator Company to recommend the insulation best suited to your particular application. For a quick, accurate solution to your insulation problems — send your specifications and requirements to our Technical Service Department.

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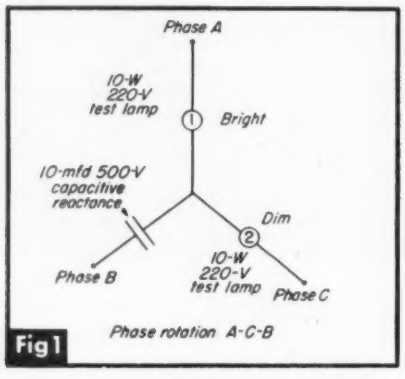
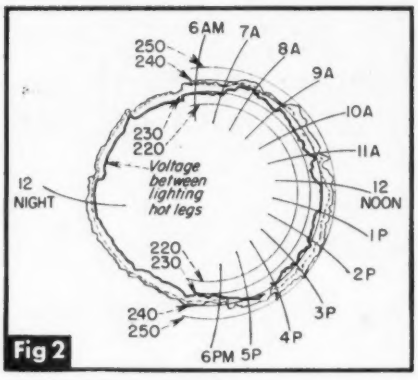
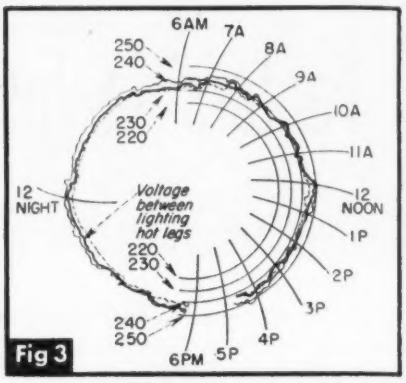


SIMPLE phase-rotation meter made of two 220-v, 10-w test lamps, one 10-mfd capacitor. When lamp 1 is brighter than lamp 2, phase A leads phase C Phase rotation is A-C-B



VOLTAGES of all three phases of open wye-open delta bank with 37½-kva lighting transformer before power transformer (7½ kva) was changed from lagging phase to leading phase



VOLTAGE RECORD of same bank after power transformer was changed to leading phase. Lighting voltage has been increased from 230 v to 240 v over peak load period

for phase position throughout the system or complete mapping of the system may be provided, it is occasionally necessary to check phase sequence in the field. This can be done by a standard phase-rotation meter, or by a simple device made from two test lamps of equal wattage and a capacitor connected as in Fig 1. For the case shown where the rotation is A-C-B, the large (lighting) transformer should be connected across the lagging phase CA to supply single-phase power, the small (power) transformer across the leading phase AB.

Pacific Gas and Electric Co has adopted this practice as standard for connection of open wye-open delta banks. This has corrected several serious voltage complaints. The accompanying charts show three-phase voltages on an open-delta bank consisting of a 37½-kva lighting transformer and a 7½-kva power transformer, both 2.4 kv. Changing the small transformer from the lagging to the leading phase not only brought the lighting voltage up from a 230-v minimum to a 240-v minimum over the peak, but also remedied improper operation of automatic throwover controls on two pump motors.

Where the ratio of single-phase load to three-phase load justifies the open wye-open delta connection, this standard method of connecting the larger transformer in the lagging phase will improve performance of the bank. The method is also applicable to the less commonly used open delta-open delta connection.

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How Many Capacitors Can Be Economically Applied?

SAM H. POLLOCK
Assistant Supervisor
Overhead Lines Dept
Kansas City Power & Light Co
Kansas City, Mo.

IT IS EASY to determine when shunt capacitors should be applied to a circuit or a part of a circuit. But it has not been so easy to determine how many to apply. However, by differential calculus, this can be found.

To find the economic limit for the application of capacitors for load reduction, the rate of change must be known of the kilovolt-amperes at any power factor as the reactive kilovolt-amperes is varied. By differentiating the following equation, it can be proved that "at any power factor angle Θ the rate of change of the kilovolt-amperes as the reactive kilovolt-amperes is changed varies as the sin Θ."

$$\text{kva} = \text{kw} \pm \text{jkvar} \quad (1)$$

This can be written as:

$$(\text{kva})^2 = (\text{kw})^2 + (\text{kvar})^2 \quad (2)$$

or:

$$\text{kva} = \sqrt{(\text{kw})^2 + (\text{kvar})^2} \quad (3)$$

By differentiating the kilovolt-amperes with respect to the reactive kilovolt-amperes, the rate of change of the kilovolt-amperes with respect to the reactive kilovolt-amperes is obtained.

$$\frac{d(\text{kva})}{d(\text{kvar})} = \frac{2\ \text{kvar}}{\sqrt{2\ (\text{kw})^2 + (\text{kvar})^2}} \quad (4)$$

$$= \frac{\text{kvar}}{\sqrt{(\text{kw})^2 + (\text{kvar})^2}} \quad (5)$$

Substituting from Eq 3 for the quantity under the radical sign, Eq 5 becomes:

$$\frac{d(\text{kva})}{d(\text{kvar})} = \frac{\text{kva}}{\text{kva}} \quad (6)$$

But by definition, sin Θ equals the reactive kilovolt-amperes divided by the kilovolt-amperes. Thus, by making this substitution in Eq 6

$$\frac{d(\text{kva})}{d(\text{kvar})} = \sin\theta \quad (7)$$

Eq 7 is proof of the statement that "at any power factor angle Θ the rate of change of the kilovolt-amperes as the reactive kilovolt-amperes is changed varies as the sin Θ." The following expansion puts the equation in a usable form. Eq 7 can be written as follows:

$$d(\text{kvar}) = \frac{d(\text{kva})}{\sin\theta} \quad (8)$$

Thus, at any power factor angle Θ the number of reactive kilovolt-amperes required to reduce the load one more kilovolt-ampere is given by Eq 9:

$$\text{kvar} = \frac{1}{\sin\theta} \quad (9)$$

At any power factor angle Θ, the cost

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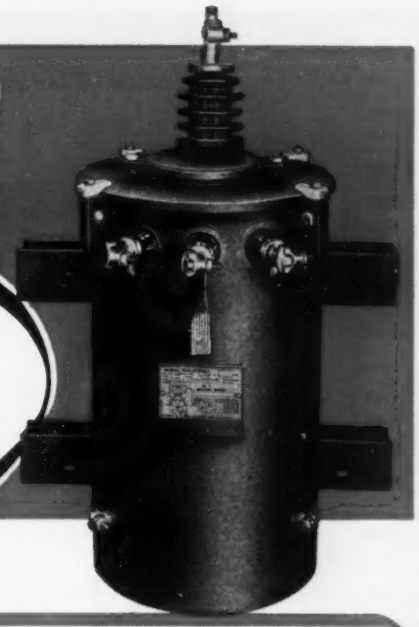

Wagner Electric Corporation, pioneer builders of transformers, offers a complete line of repair parts and reconditioning service for Wagner Rural Line Transformers — Genuine Repair Parts for "on-the-spot repairs" . . or a "Factory Reconditioning Service" for transformers that need a complete overhauling.

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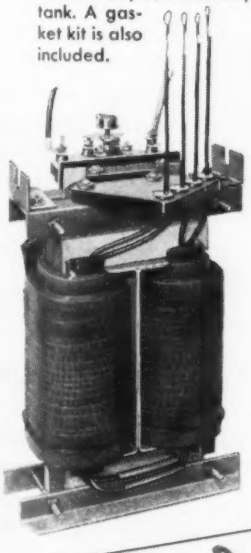
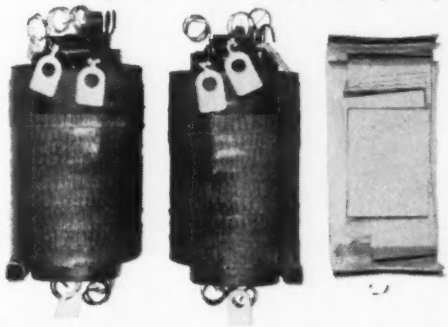
This service consists of cleaning and painting of transformer, installing all new gaskets, installing new factory-wound coils and insulation and a thorough factory test. A one year guarantee against defective material and workmanship applies on all transformer rebuilding jobs. Ship transformer to us prepaid and we will pay return freight charges. Oil, broken or missing bushings, De-Ion gap or other major parts are extra. If the transformer does not require complete rebuilding, repairs will be made on a time and material basis.

Repair Parts . . .

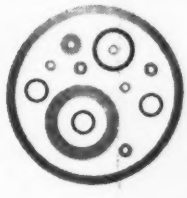
All transformer repair parts are Genuine Wagner Parts, and exact duplicates of those they replace. A few are listed and described.

NEW INTERIOR
consists of a new core-and-coils completely assembled with a terminal board or tap changer, if needed, with leads ready to install in your tank. A gasket kit is also included.

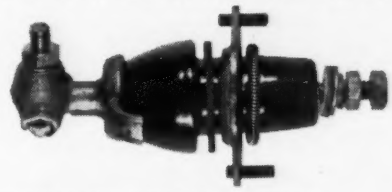




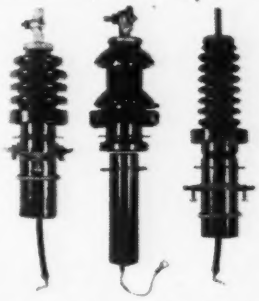
COILS AND INSULATION
consist of a complete set of coils and all necessary insulation for mounting on your core. A gasket kit is included.



GASKET KIT
consists of a complete set of all gaskets used throughout the entire transformer.



LOW VOLTAGE BUSHING ASSEMBLY
consists of the parts as illustrated above.



HIGH VOLTAGE BUSHING ASSEMBLY
consists of the parts as illustrated at left. High voltage bushing assemblies do not include fuse. If transformer is equipped with a fuse, cost is extra.

TRANSFORMER OIL
Genuine Wagner Transformer oil is available in 1, 3, 5, 20, 30, and 50 gallon containers.

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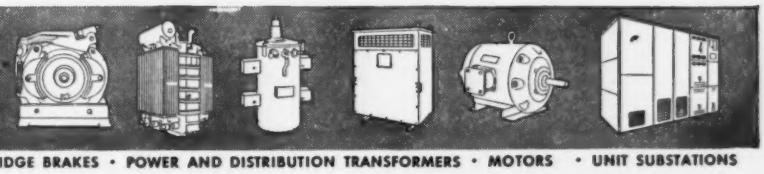

T47-19

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This is No. 0342 clevis with No. 355 wet process porcelain spool—from a complete line of Locke clevises and spools which are designed together and made together to work together.

The clevis is designed and made to receive all 3-inch spools—thus simplifying your stocking problem. A ⅝-inch bolt can be inserted in the slotted mounting hole even with the spool in place.

The steel clevis is formed from heavy stock—providing a high factor of safety for maximum working loads. And, of course, with *Permazinc*—Locke's *Quality Controlled* double hot-dip galvanizing—for extra years of dependable service.

The spool is of wet process porcelain for best electrical characteristics, with *Compression Glaze*—originated by Locke—to provide highest strength.

Depend on Locke for *Quality Controlled* distribution materials—pole line hardware and insulators. *One* order covers *both*.

Locke

POLE LINE HARDWARE *and* INSULATORS

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to reduce the load one more kilovolt-ampere is the cost to install the number of reactive kilovolt-amperes as determined by Eq 9. Written as an equation this becomes:

$$\text{Cost to reduce the load one more kva} = \frac{\text{cost to install one kvar}}{\sin\theta} \quad (10)$$

This can be written as:

$$\sin\theta = \frac{\text{cost to install one kvar}}{\text{cost to reduce the load one more kva}} \quad (11)$$

The economic limit will be reached when "the cost to reduce the load one more kilovolt-ampere" is equal to "the value per kilovolt-ampere of the overloaded equipment." Making this substitution in Eq 11 gives:

$$\sin\theta = \frac{\text{cost to install one kvar}}{\text{value per kva of the overloaded equipment}} \quad (12)$$

In practice, by substituting dollar values in Eq 12, the most economical operating power factor is obtained. For example, to find the most economical operating power factor in a substation valued at $26.80 per kva where installed capacitors cost $7.50 per kvar, substitute in Eq 12

$$\sin\theta = \frac{\$\ 7.50}{\$26.80}$$

$$\sin\theta = 0.28$$

$$\theta = 16.28 \text{ deg.}$$

$$\text{Power Factor} = \text{Cos}\ \theta = 0.959$$

Thus, enough shunt capacitors to raise the power factor to 95.9 percent could be added to the substation and the cost justified entirely on a load reduction basis. Although load reduction is only one of the factors to be considered in the application of capacitors, the formula is most helpful in studying the economics of many such installations.

•

Mobilization for Utility Emergencies

A NEW ENGLAND UTILITY handles emergencies in the following manner. Any company employee, noting unusual conditions of concern to the line department, must notify immediately the distribution superintendent, the assistant, or secretary. If the office is closed, he informs the trouble operator.

The trouble operator (or the superintendent) immediately calls a selected list of men. The highest ranking

The dimension that "specs" don't cover

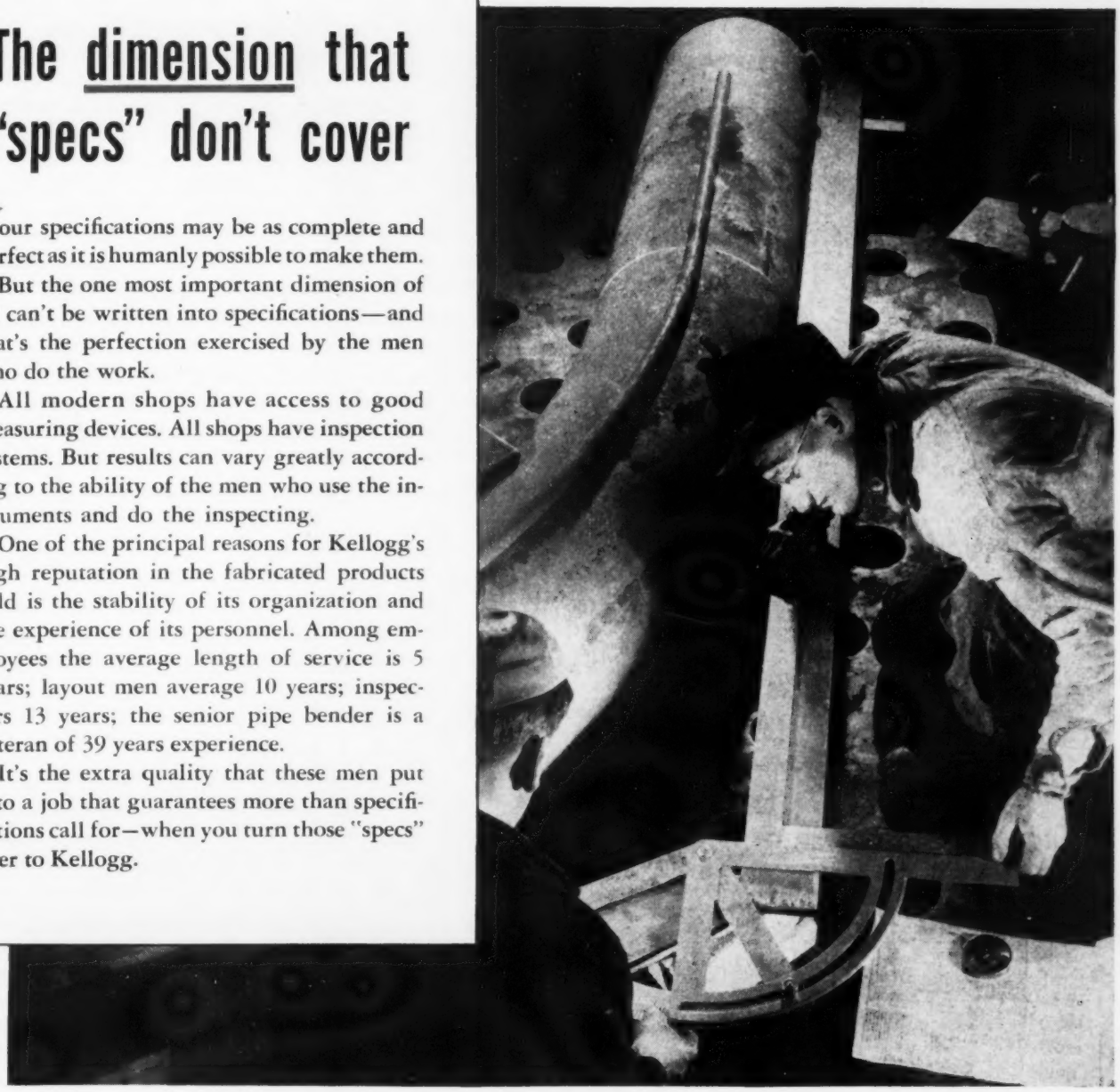
Your specifications may be as complete and perfect as it is humanly possible to make them.

But the one most important dimension of all can't be written into specifications—and that's the perfection exercised by the men who do the work.

All modern shops have access to good measuring devices. All shops have inspection systems. But results can vary greatly according to the ability of the men who use the instruments and do the inspecting.

One of the principal reasons for Kellogg's high reputation in the fabricated products field is the stability of its organization and the experience of its personnel. Among employees the average length of service is 5 years; layout men average 10 years; inspectors 13 years; the senior pipe bender is a veteran of 39 years experience.

It's the extra quality that these men put into a job that guarantees more than specifications call for—when you turn those "specs" over to Kellogg.



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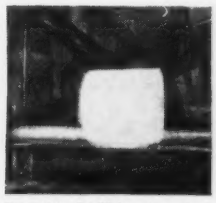

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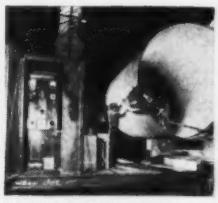

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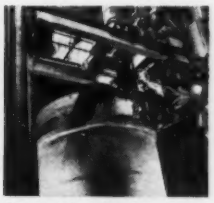
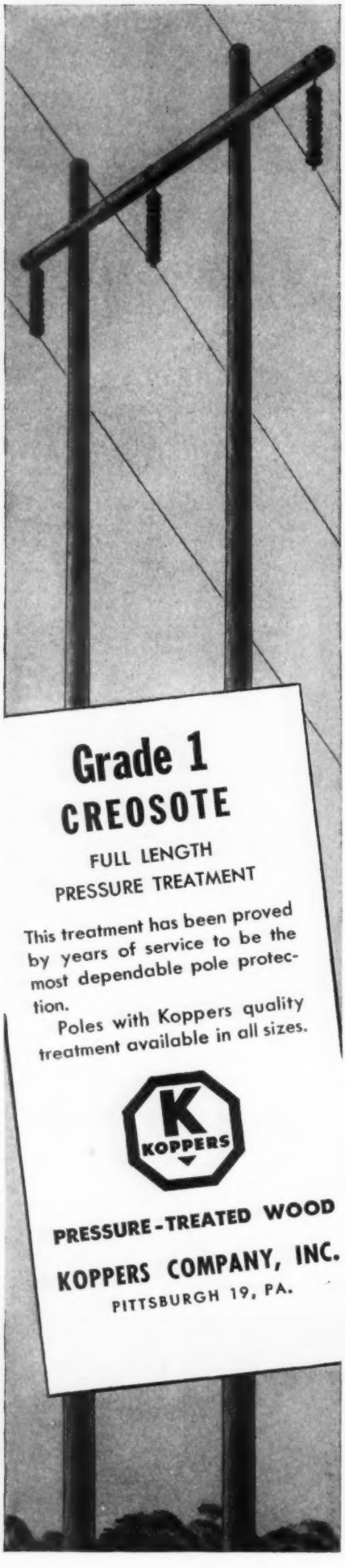
On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.



man available on this list is put in charge. In this particular company, the assistant superintendent, a technical assistant (special tests and records), the maintenance engineer, and construction foreman (electrical) comprise the listing. If none of these men is available the trouble operator calls such help as required. But efforts are continued to contact the highest man available on the call list.

Scheduled Operations

Outside office hours, these men (except the assistant superintendent) operate on a schedule. This provides for reasonable accessibility at all times by telephone or messenger. Substitutions can be made if they are found to be necessary.

During an emergency, only top priority telephone calls are handled. Extra personnel is often assigned to expedite these. The electrical construction foreman, general line foreman and maintenance supervisor are kept constantly informed of the emergency. They are subject to call if conditions warrant. Provision is also made for notifying other officials of the company.

The man in charge of the emergency operation reports progress of field work to the trouble operator. This enables needed information to be transmitted quickly. Garage men are held at the main building for special service. Calls for linemen, stockmen, etc, follow a fixed rotation schedule.

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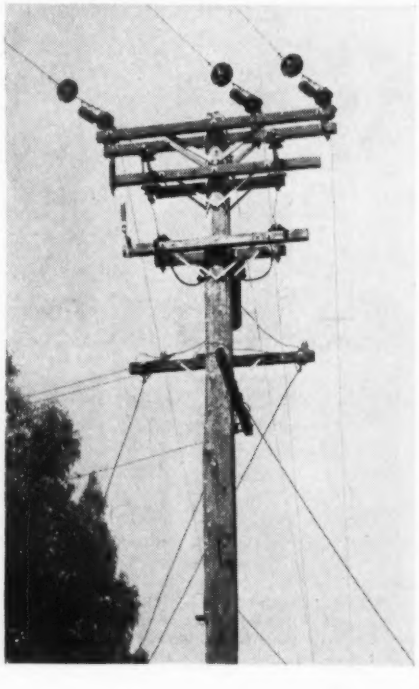
Three-Phase Rural Power Line Carrier

ONE of the first two applications of carrier to *three*-phase rural power lines for commercial telephone service is near San Rafael, Calif. It is on a five-mile, 11-kv line of Pacific Gas and Electric Co. The carrier channel consists of one-phase wire and earth ground. Several single-phase applications that have been made to rural lines utilize the phase wire and the metallic grounded neutral.

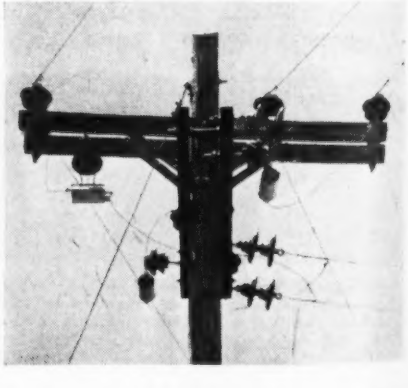
Coupling to the three-phase power line is made to one of the conductors through a 1-amp Trip-O-Link fuse and a tube-mounted 0.002-mf condenser. These may be seen in one of the accompanying photographs. Series line chokes, blocking off the carrier, are required on the power take-off pole and in any tap lines that have no telephone subscribers. The chokes are shown in the photograph.

An earth ground introduces a problem of securing sufficiently low resistance. In this application, resistances of 6 ohms were obtained with driven rod grounds. In respect to the equipment used, this installation is similar to the original test application described in ELECTRICAL WORLD, August 4, 1945, page 94.

POWER COMPANY terminal or take-off pole showing series line chokes in the three line wires and the 1-amp fuse and coupling condenser at the left end of the arms. Metal box further down on pole contains filters, drainage coil and switch



THREE-PHASE tap line contains series chokes to block off line as no telephone subscribers are served from it



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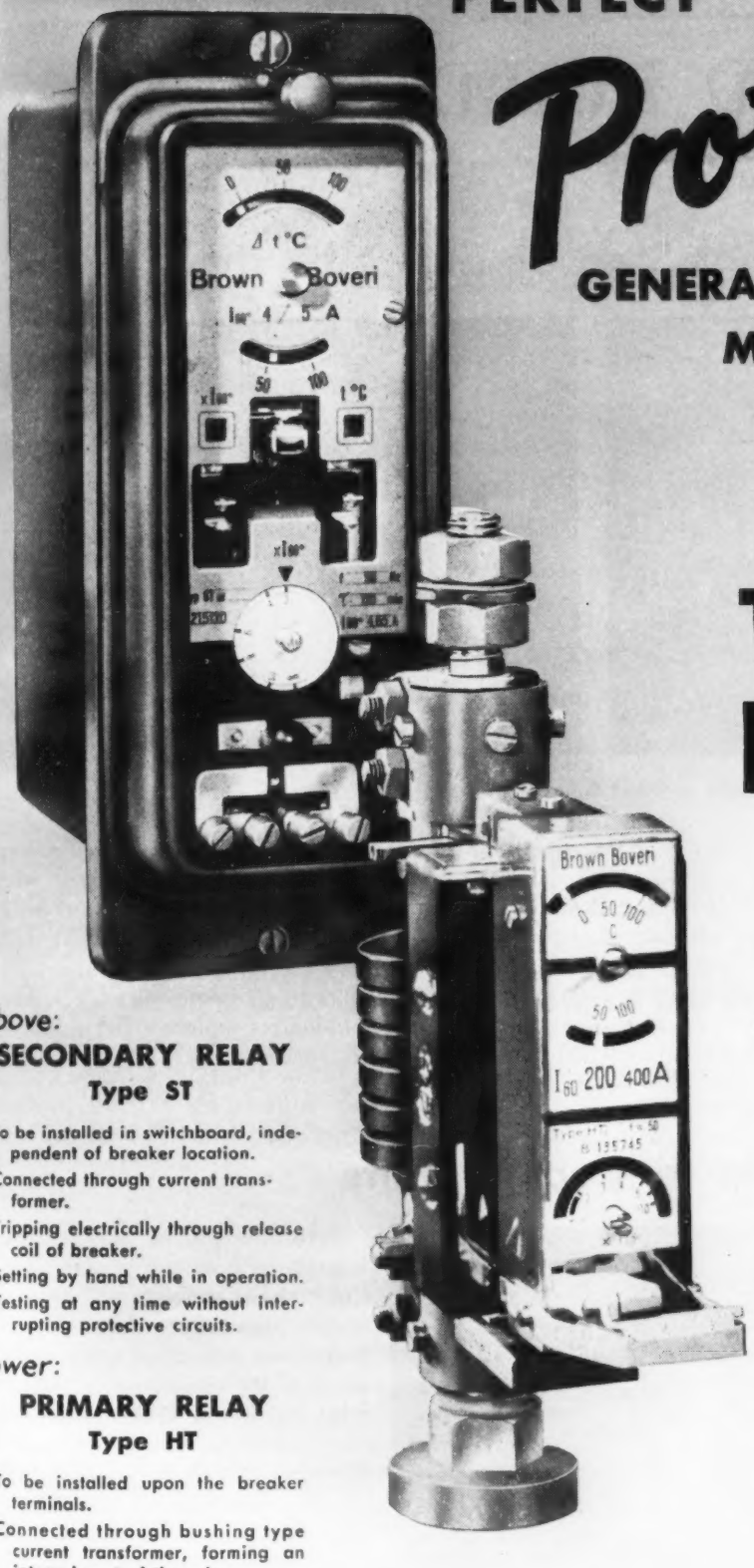

Above:

SECONDARY RELAY
Type ST

To be installed in switchboard, independent of breaker location.
Connected through current transformer.
Tripping electrically through release coil of breaker.
Setting by hand while in operation.
Testing at any time without interrupting protective circuits.

Lower:

PRIMARY RELAY
Type HT

To be installed upon the breaker terminals.
Connected through bushing type current transformer, forming an integral part of the relay.
Tripping mechanically through levers and insulated push rod.
Setting by insulated operating rod.

By forming a true thermal picture of the object to be protected, Brown Boveri Thermal Relays stand ready to act whenever the load conditions cause the temperature to rise above the safety limit.

Thermal protection is no substitute for short circuit protection through overcurrent relays; it is a supplementary safety device — acting even on small overloads when they are applied for a dangerous length of time.

Our specialists will gladly study your particular protection problems — and suggest proper solutions.

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SWITCH GEAR

VOLTAGE REGULATORS

RELAYS

GAS TURBINES

LOAD BUILDING

Mercury Lamps Step Up Street Lighting

BEFORE AND AFTER VIEW showing striking improvement in street lighting in Greeley, Colo., with new 20,000-lumen mercury lamps

FIRST full-size installation of the new 20,000-lumen mercury street lights to be made anywhere in the country is in Greeley, Colo. This system consists of 167 standards, each with the new Westinghouse EH-1, 400-w, 20,000-lumen horizontal luminaire. Standards are in opposite arrangement, 133 ft apart, with four at each intersection. Street width is 76 ft; mounting height 33 ft 7 in.

The old street lights produced 2,500 lumens, 13 percent of which was utilized, resulting in 325 lumens on the street. The new mercury lamps give 5 percent or 9,000 lumens on the street. This is 27.5 times the previous amount of effective light. At intersections eight old luminaires delivered 2,600 lumens on the street; the four new mercury units deliver 36,000 lumens. In a downtown block, six new luminaires replace eight old and give 21 times the light.

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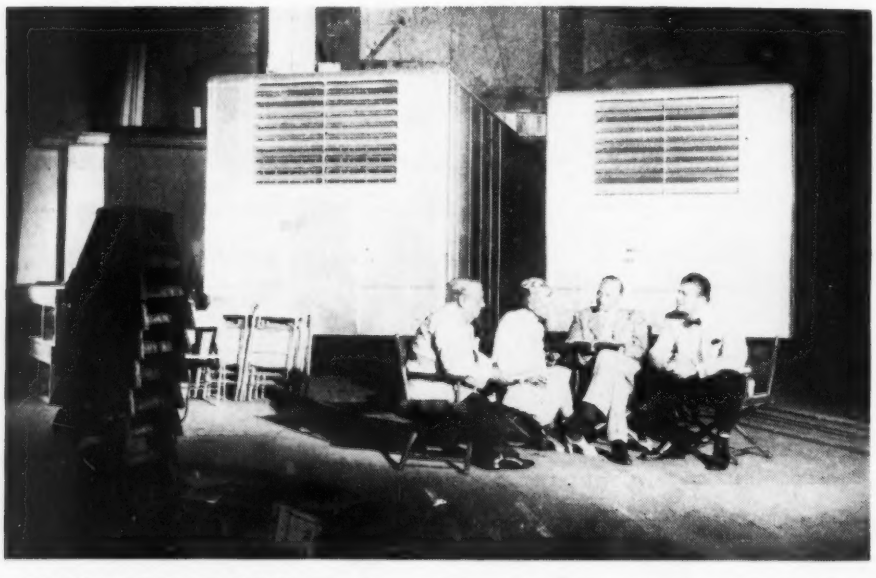
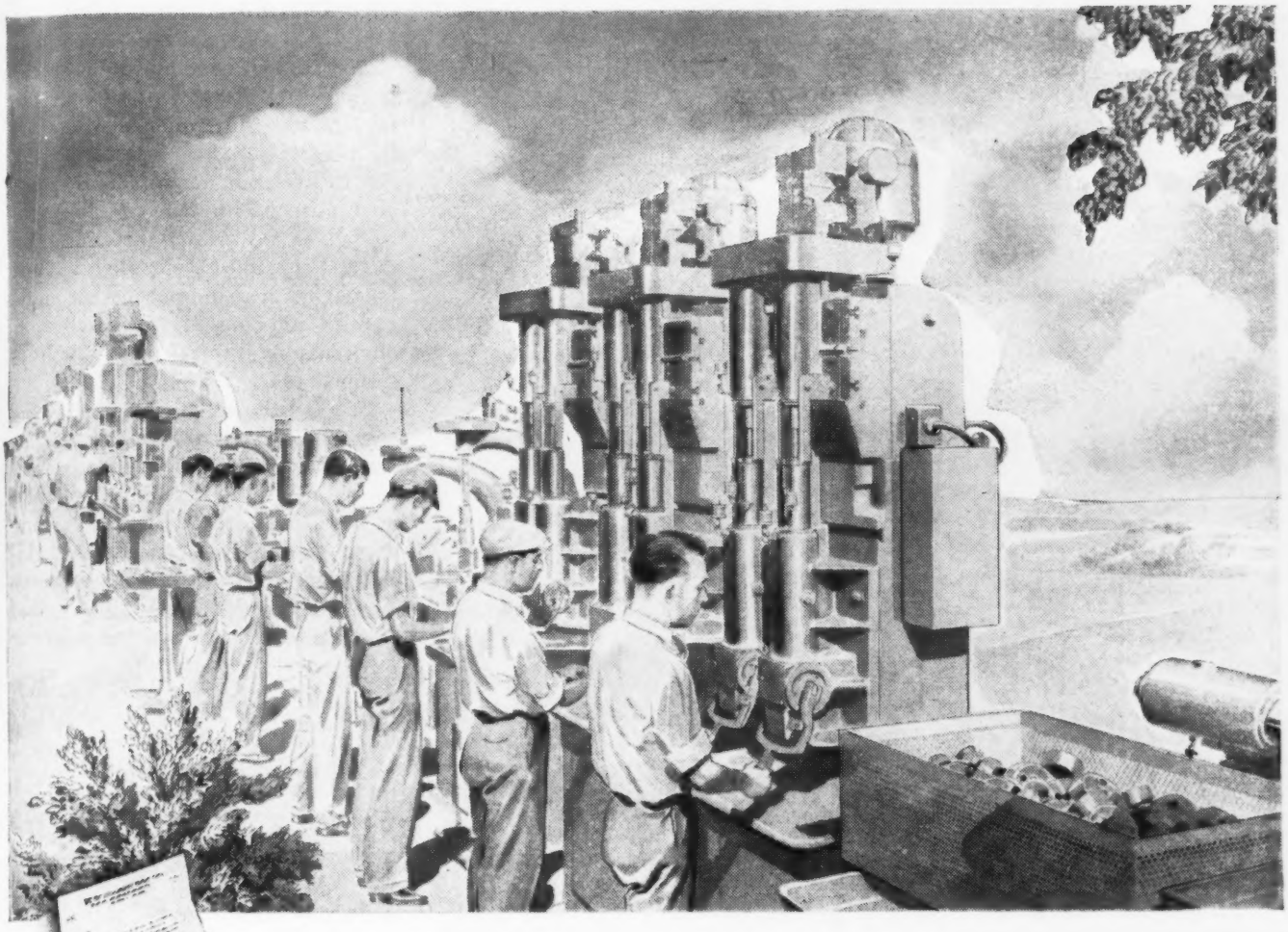
Mobile Air-Cooling Units



COMPLETELY SELF-CONTAINED, these cooling units need only cooling water, waste water and power connections to go into operation. Adjustable vertical and horizontal louvers direct cool air to any spot

SPOT COOLING by mobile air-cooling units has solved for Warner Brothers the problem of intense heat from high-level illumination on technicolor sets. First two units were designed with warehouse stock equipment by C. G. Hokanson, General Electric's southern California air-conditioning distributor, as an emergency project for "Life With Father." They proved so satisfactory the studio asked for a package mobile unit to be mounted on a trailer complete with cooling water, waste water, and power connections designed to facilitate moving from set to set. Eight of these units are now operating, and four more have been ordered by the studio.

Principle advantage of the unit is mobility. Each has mounted on its self-contained four-wheeled trailer



"Like moving your plant outdoors"

IT took a lighting engineer to put into words the improvement made in the average industrial plant by a clean, fresh coat of white paint on walls and ceilings. Said he in describing a job recently done in one plant with Barreled Sunlight:

"It's like moving your plant outdoors!"

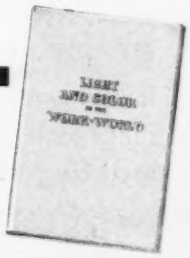
That's really an excellent description, for white ceilings and walls reflect and distribute artificial illumination just as the sky reflects and distributes natural sunlight outdoors.

By reflecting a maximum of light (80 to 90%—far more than paint of any other color) white ceilings and walls help make even the finest lighting system more efficient.

And by *distributing* it evenly throughout the entire working area they help to banish those three arch-enemies of good seeing: glare, harsh shadows and extreme contrasts in brightness.

For nearly half a century, Barreled Sunlight whites have been helping to make good lighting better. For down-to-earth data on the partnership of Light and Paint in creating good seeing conditions, send today for free copy of our 32-page booklet, "Light and Color in the Work-World."

BARRELED SUNLIGHT



U. S. GUTTA PERCHA PAINT COMPANY
14-K Dudley Street, Providence 1, R. I.

I'd like to know more about the partnership of Light and Paint. Please send me your free 32-page booklet, "Light and Color in the Work-World."

COMPANY .....

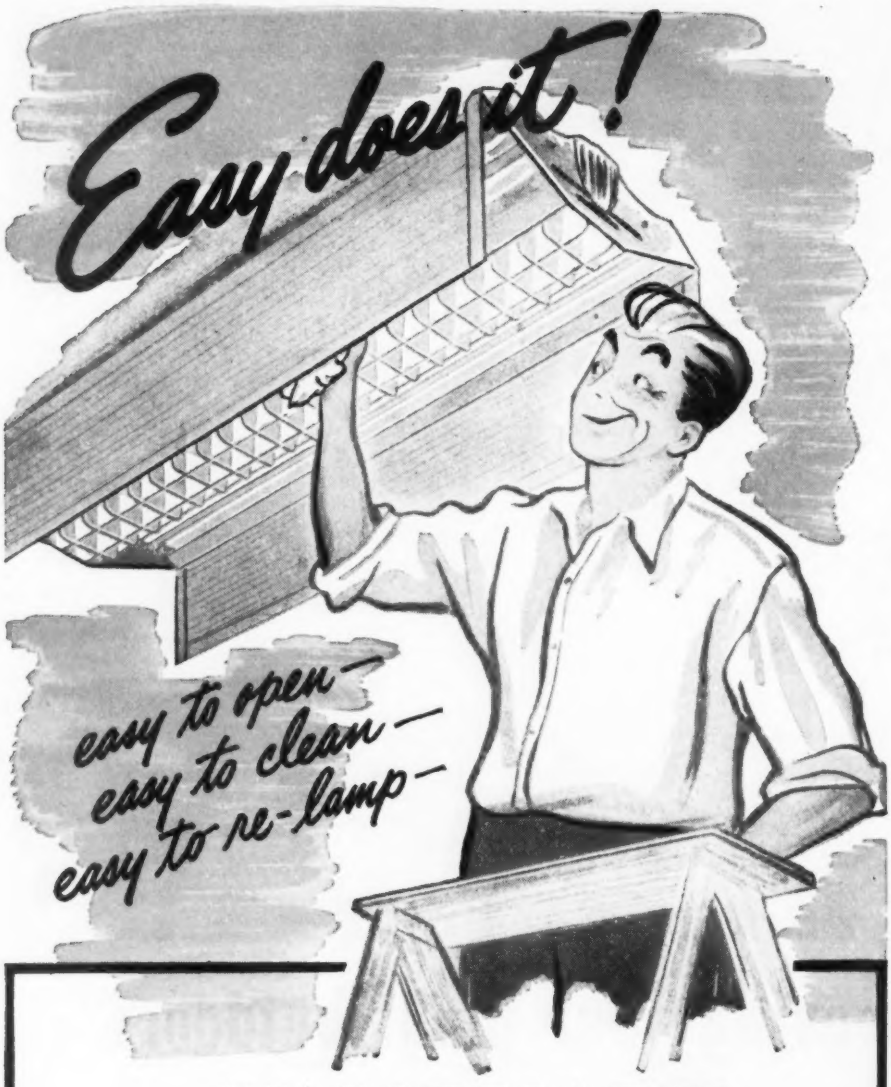
STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

MY NAME IS .....

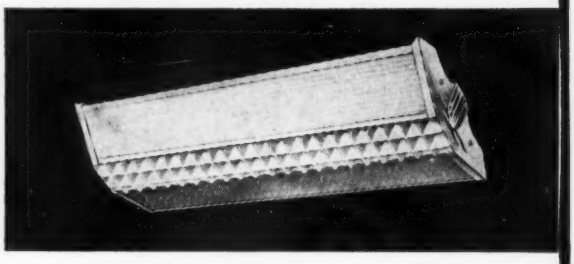
MY TITLE .....

© 1947 U. S. Gutta Percha Paint Company



The VANGUARD

Newest SILV-A-KING Fluorescent Fixture . . . for commercial installations



No more dangerous high-ladder gymnastics . . . no more fancy tools . . . no more lacerated fingers or strong language! The Vanguard opens as easily, quickly, and safely as your fountain pen—for inspection, cleaning, or re-lamping.

For assurance of minimum maintenance time . . . Specify the Vanguard!
I. B. E. W., A. F. of L. • Listed by Underwriters' Laboratories, Inc.
Yours for the asking, "Vanguard" Bulletin No. 447FV

SILV-A-KING LIGHTING EQUIPMENT SINCE 1921

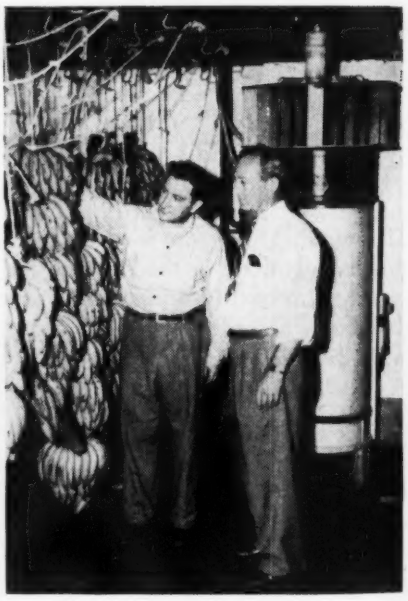
BRIGHT LIGHT REFLECTOR COMPANY, INC.
Subsidiary of Bridgeport Pressed Steel Corp.
FAIRFIELD AT STATE • BRIDGEPORT 5, CONN.

one 30-hp, Freon water-cooled compressor, two specially designed coils with a two-speed motor blower, incoming air filters and outgoing air louvers with all equipment necessary for control. The two sets of louvers, one vertical, one horizontal, are operated independently and can direct the cool air in any desired direction. This method is said to accomplish with 60 tons of cooling equipment what might require 500 tons of refrigeration in an orthodox central plant type of system.

Successful use of this equipment suggests additional applications in many other totally unrelated fields where mobility, flexibility and low cost per unit are important. Among the possibilities are auditoriums, indoor sports arenas and other places where the combination of hot humid weather and large gatherings occur infrequently.

•

Heat Pumps Pay Heat Dividends



BANANAS ripened by reverse cycle refrigeration system. Evaporator unit in rear delivers heat pumped out of cold-storage room. Temperatures can be varied under close control

A SYSTEM of reverse cycle refrigeration used by the Spector Produce Co of Phoenix, Ariz., provides flexible operation and efficient utilization of waste heat. In this wholesale fruit and vegetable plant, the heat pump is used for pre-cooling and storage at temperatures as low as 0 deg F. It is also used for ripening green prod-

Build LINE SECURITY *with* CHANCE ANCHORS

...All-Steel SCREW ANCHORS are Double-welded for Greater Strength!

Chance All-Steel Screw Anchors have a smaller hub and a thinner, faster-cutting, more accurately pitched blade than any other type of screw anchor. This advancement in screw anchor construction is possible because the spiraled blades are forged separately from the rods, or hubs as in the wrench type, and then welded together above and below the blade or helix. Thus the helix in every size is correctly pitched, tapered, and sharpened for easy installation with minimum earth disturbance. The small hub on these anchors increases holding power by allowing a greater holding surface.

The Swamp Anchor, of cast malleable iron, is as carefully designed as the steel screw anchors, and also features a sharpened cutting edge to aid in cutting through roots.

These anchors are favorites with many construction men because of the ease and speed with which they can be installed.

Easy to Install

The Chance No-Wrench Screw Anchor requires only a rod through the eye to screw the anchor down.

TRIPLEYE ROD

. . . Admits bar for use as "wrench"

The forged steel Tripleye on the rod will accommodate one, two, or three guy strands. It has the new full-rounded eye that protects the guy strand and prevents kinking.

WRENCH TYPE SCREW ANCHOR

This anchor permits the use of a small anchor rod, since installation strain is applied directly to the hub of the anchor instead of the eye of the rod. Constructed entirely of steel, this double-welded anchor is furnished with a Chance Thimbleye Nut, which has a full round eye to protect the guy strand and aid in slack pulling.

CHANCE SWAMP ANCHOR

Especially adapted for installation in swamps, bogs, marshes, and quicksand. Designed for guying applications in the most adverse soil conditions, it develops extremely high holding power when deeply set. The Swamp Anchor has a large Tripleye nut to accommodate one, two, or three guys.

NO-WRENCH SCREW ANCHOR

This anchor consists of a drop-forged, galvanized steel rod, double arc welded to a forged steel helix. It has been thoroughly tested to pull several times its rated holding power. These tests prove that the No-Wrench Screw Anchor is far superior in holding power to all other screw anchors tested.

How much will an anchor HOLD?

Chance engineers have developed a new formula for determining the type and kind of anchor to use for every guying condition. Your copy is ready and will be sent upon request.

C4723

A·B·CHANCE CO·

CENTRALIA, MISSOURI • SAN FRANCISCO, CALIFORNIA

ABC INDUSTRIES

FOR
STRENGTH
AND
DURABILITY!
Silicon
BRONZE
BOLTS

Extra strength ... resistance to corrosion ... resistance to season cracking ... these are some of the qualities of Harper Silicon bronze fastenings which have led to their use by scores of power companies and electrical equipment manufacturers. These fastenings go into sub station assemblies, pot heads, pole line hardware, grounding equipment, and a host of other applications.

5200 ITEMS IN STOCK

Harper maintains a large and widely assorted stock of Silicon bronze bolts, nuts, screws, washers, and rivets. Moreover, similar stocks are maintained in brass, naval bronze, copper, Monel and stainless steel. Ask for summarized catalog.

ASK HARPER ENGINEERS

Harper engineers specialize in the manufacture and use of non-ferrous and stainless fastenings. Submit your fastening problems to them.

The H. M. HARPER COMPANY
2611 FLETCHER STREET
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EVERLASTING FASTENINGS

uce for market at higher temperature ranges.

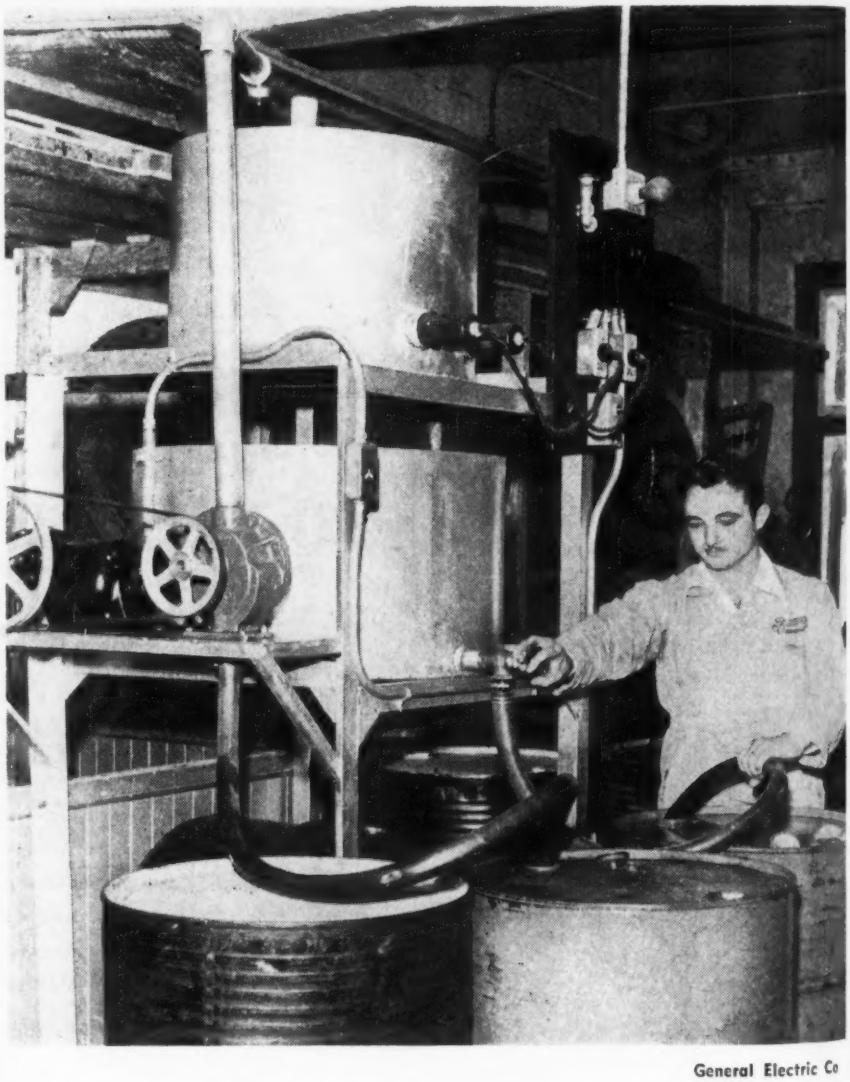
One of the five storage rooms is shown in the picture. Bananas are ripened by gradual increase of temperature under close control. Each room can be kept at any temperature from 0 to 100 deg F. Typical operation uses one room for cold storage of frozen foods at 0 deg; another for pre-cooling at 38 deg; and three for ripening green bananas in a range that varies from 56 to 70 deg.

The installation, designed by Gay Engineering Co of Los Angeles, consists of two standard 10-hp compressor units, five cylindrical evaporators, and one atmospheric condensing tower. The tower eliminates the necessity for maintaining balance of heating and cooling loads in the various rooms. The evaporators can function in the dual role as condensers for heating.

The heat taken from the low temperature room would normally be dissipated into the atmosphere by conventional refrigeration. Saving results from utilizing this heat for ripening.

• • •

Electric Heating Saves Expensive Egg-Sealing Oil



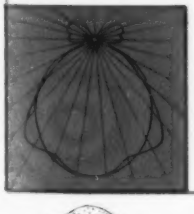
General Electric Co

ELECTRIC HEAT permits the re-use of an expensive oil used to seal the shells of eggs before they are put in cold storage. Broken eggs must be removed from the oil daily. This is done by piping the oil into a tank and heating to about 222 F by two Calrod oil immersion heaters thermostatically controlled. The heat hardboils the suspended egg matter and sterilizes the oil. The oil is then drained from the heating tank through screens which remove the congealed substance. This process is used repeatedly with very little loss of oil by O. Casperson and Sons, San Francisco, Calif. Considerable savings result from the use of this process

RIGHT FOR THE EYES!

The new, improved GUTH Futurliter * distributes illumination scientifically throughout an entire area. A soft, pleasing *ceiling light* relieves contrasts and harsh shadows, and makes for easy, over-all, restful seeing. And then, powerful, controlled *down-light* provides seeing acuity through shielded, diffusing high intensities. GUTH Futurliters are smartly styled and harmonize with most interiors. They can be mounted directly to the ceiling, or they are suitable for suspended mounting. They can be arranged in continuous rows or as individual units. The standard Futurliter is made with "300° White" Enamel Reflectors. However, it is also available with Alzak Aluminum Reflectors and Side Baffles. The fixture may be used with or without GUTH Eggcrate Louvres.

THE RIGHT LIGHT CURVES IN THE RIGHT PLACES!



The GUTH Futurliter is designed to distribute 20% of its illumination output upward . . 80% downward . . for best workmanship and seeing efficiency. This balance of lighting has been found highly successful and satisfactory in use

EYE-TO-THE-FUTURE ADAPTABILITY

GUTH Futurliters have flexible foot candle capacity. At the outset, two 40W tubes may be used in each luminaire. Later the simple addition of sockets and ballasts will accommodate a third lamp; increasing the light output by as much as 45%.

OUR 45th ANNIVERSARY Year

* Trade Mark Registered — Patents Pending

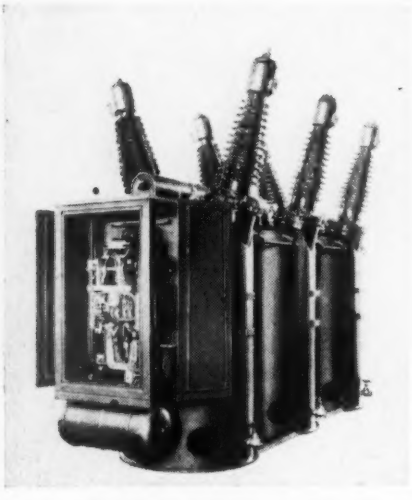
Write today for full details about The GUTH Futurliter

THE EDWIN F. GUTH CO. • 2615 WASHINGTON AVE • ST. LOUIS 3, MO.

Guth Leaders in LIGHTING SINCE 1902

NEW EQUIPMENT

Oil Circuit Breakers



AN IMPROVED LINE of high-voltage, high-speed, quick-clearing, outdoor, floor-mounted oil circuit breakers, Type BZO-160, has been announced by the Boston Works of the Allis-Chalmers Mfg Co.

These redesigned units in ratings from 115 kv to 230 kv, up to 3,500,000-kva interrupting capacity, are reported to meet the requirements for transmission line circuit breaker protection. Important features retained in the Type BZO-160 breaker to insure circuit interruption within 5 cycles, reclosing service within 20 cycles, include the single-break, 5-cycle Ruptor arc extinguishing device, and the improved pneumatic operator with self-contained automatic air supply system.

External conduit has been eliminated on the side of the improved breaker. Tank diameter is decreased and cuts down the oil required.

Other major improvements include a weatherproof mechanism box on top of each tank; an improved oil and gas seal for pole unit tanks; provisions for removing either bushings or bushing current transformers without disturbing the other. In addition, complete oil maintenance facilities are afforded on each pole unit tank by means of a fill valve and combination drain and sampling valve, plus a float type of oil gage. This gage eliminates the danger of oil leakage through glass breakage.

The mechanism box includes a rotating shaft with cranks and bronze bearings to connect the contact lift rod to the horizontal pull rod. This unit not only forms a corrosive resistant bearing combination, but also serves as an efficient oil and gas seal, isolating each pole. The mechanism box also encloses the bushing current transformer terminal blocks.

•

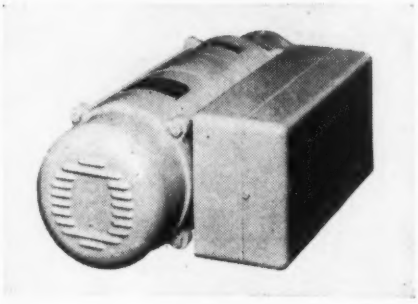
Airport Runway Light

A NEW, type HL, airport runway light announced by Westinghouse Electric Corp, East Pittsburgh, Pa., is said to outline runways under all visibility conditions from clear moonlight nights to zero-zero daytime. Conforming to CAA Specification L-820, the light is actually two units in one; an upper, low-intensity unit that can be varied in five steps from 16- to 1,600-candlepower intensity and a lower, high-intensity unit that gives an additional five steps from 1,000- to 100,000-candlepower intensity.

The high-intensity light is produced by two unidirectional, sealed-beam lamps located at opposite ends of a barrel-shaped housing, each supplied from a separate circuit operated off a standard brightness control regulator. When used during restricted visibility, the unidirectional light prevents lighted haze or fog curtains behind the light.

The low-intensity lamp is located within an asymmetric lens assembly mounted on top of the high-intensity housing. During normal visibility, this bi-directional element provides visual identification of the runway from horizon to zenith for any direction of approach, and insures color fidelity during operation at very low brightness. Color screens can be used when desired.

Electronic Amplidyne



AN ELECTRONIC AMPLIDYNE consisting of a high-gain balanced d-c electronic amplifier and a motor amplidyne has been announced by the Motor Divisions of the General Electric Co, Schenectady, N. Y. The new amplifier is a high-capacity amplifier which is useful in many types of motor control where precise regulation of current, voltage, and speed is necessary. A speed range of 20 to 1 or greater is stated to be obtainable.

The unit is designed for use as a regulated adustable-voltage power supply for d-c motors up to 1½ hp and as a regulated exciter for larger adustable-voltage drives up to 200 hp. It has an output of 1½ kw, 250 v and is arranged for use on either a 220- or 440-volt, 3-phase, 60-cycle power supply.

•

Sparkproof Cable

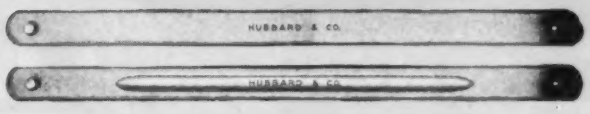
A CABLE that is said not to spark when damaged has been developed to aid in the prevention of coal mine explosions. It is manufactured by United States Rubber Co, Rockefeller Center, New York 20, N. Y. Conductor sizes range from No. 4/0 to 8 AWG of flexible stranded copper. Rating is 600 v. This type of cable is used to transmit power to equipment employed in digging and transporting coal. Trailing on the ground, the cable is in danger of being damaged.

Feature of the cable is a fine strand of copper wire as part of the braid over the Buna S on the positive conductor. Negative conductor has Neoprene covering. Outside jacket of the cable is yellow Neoprene.

Function of the fine wire is to catch incipient current leakage before an arc can occur in the event of damage to

UNSUNG HEROES OF POLE LINE CONSTRUCTION

Simple things, CROSS ARM BRACES, just a strip of flat steel with a hole punched in each end, but most important to a pole line. Hubbard Braces are fabricated from the best, new, open-hearth steel and all corners are rounded to protect linemen from sharp projections. For the engineer who wishes additional strength on the compression side of the arm, the ribbed brace is provided and offers approximately 25% added protection.

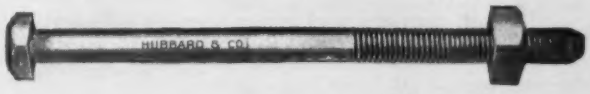


HUBBARD FLAT AND RIBBED CROSS ARM BRACES

HUBBARD ANGLE CROSS ARM BRACES, for heavy construction, are supplied in a range of spreads and drops to meet the requirements of any standard construction. Angle size runs from 1½ to 2-inches. At the pole attachment hole, the angle is so formed that wrench clearance is provided. Attachment is by ⅝-inch Machine Bolt at the pole and ½-inch Carriage Bolts at the arm.

HUBBARD ANGLE CROSS ARM BRACE

DRIVE POINT MACHINE OR CROSS ARM BOLTS are roll-threaded to provide a "finger-fit" for the full length of the thread. The "Drive Point" feature enables the bolt to be used as a drift pin for the alignment of holes slightly off center. This operation must be carried out with caution so as not to injure the threads. "Drive Point" also facilitates the application of nuts and allows bolts to be driven out of the pole for reclamation without injury to the threaded end. The major portion of Hubbard bolts of all types have this feature.



HUBBARD DRIVE-POINT CROSS ARM OR MACHINE BOLT

HUBEYE BOLTS are furnished for attachments of any kind where a thimble would normally be used. The eye of the bolt is drop-forged to a shape which provides a perfect "built in" thimble. Strand may be looped around the Hubeye with complete protection. Side walls of the eye retain the roundness of the strand. There is no possibility of kinks or strains at the loop. Hubeyes are a thoroughly tried and proven product.

HUBEYE DRIVE-POINT BOLT

STANDARD HUBBARD OVAL-EYE BOLTS are an old line item still much used in many sections. Hubbard Eye Bolts are all drop-forged with an eye that is stronger than the shaft of the bolt. Made from the best, new, open-hearth steel and Hubbard Double-Dip Hot Galvanized.

HUBBARD OVAL-EYE DRIVE-POINT BOLT

HUBBARD AND COMPANY

PITTSBURGH
CHICAGO

OAKLAND
CALIF.

WHY You Should Specify "PENTA" PRESERVATIVE TREATMENT...

for your poles, cross-arms and other exposed wood

1. Chapman "Penta" Preservative is *clean*—not sticky or unpleasant for linemen and other workers. In fact, with proper choice of solvent carrier, it is possible to treat wood thoroughly with "Penta" Preservative and have it virtually the same in appearance and feel as untreated wood.

2. Ten year tests prove that Chapman "Penta" Preservative gives you superior protection against rot, termites and other enemies of wood. No other material commercially available today can do a better job.

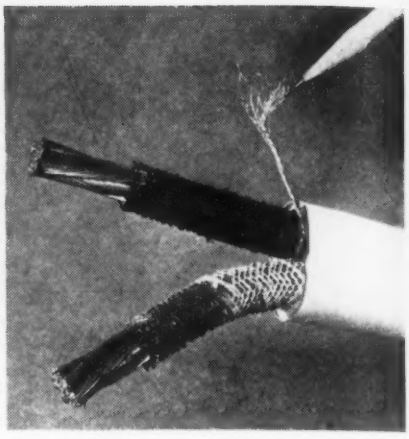
3. Chapman "Penta" Preservative costs no more than familiar materials, and treatment is applied with the same equipment and in substantially the same way as old-fashioned preservatives. That means you can buy treated poles and cross-arms—or have your own material properly treated—in any part of the U.S.

Write us for details and evidence to confirm the statements made above.

CHAPMAN

CHAPMAN CHEMICAL COMPANY
Suite 542
333 North Michigan Avenue, Chicago 1, Illinois

Chapman "Penta" Preservative contains *Pentachlorphenol*
a product of
The Dow Chemical Company



the cable. The leakage current flows through the braid to a relay which operates a circuit breaker.

•

Split-Phase Motor

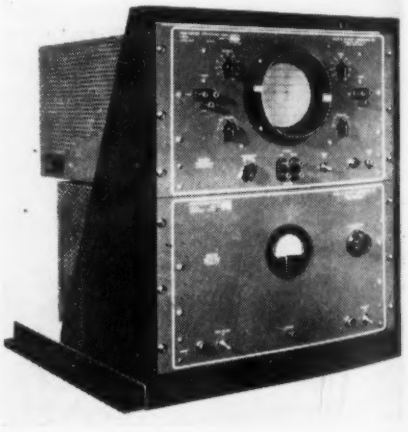
A NEW MOTOR, the C1604-25, a split-phase type, is being produced by Jack & Heintz Precision Industries, Inc. Cleveland 1, Ohio. It is rated 1/6 hp, 115 v, 60 cycles, 1,725 rpm and rotation is optional. A manual reset overload protector is built in. This motor is totally enclosed, has standard NEMA two-lug mounting flange, and is particularly suited for gun-type oil burner application.

•

Oscillograph

NEW EQUIPMENT for cathode-ray oscillography consists of two units, type 281 high-voltage cathode-ray indicator and Type 286 high-voltage power supply, available together or separately. The units are a product of Allen B. Du Mont Laboratories, Inc, 2 Main Ave, Passaic, N. J.

The indicator is a self-contained instrument featuring the Type 5RP-A multibased cathode-ray tube operating at a total accelerating potential of either 4 or 8 kv. When the type 286 is employed as an auxiliary supply, the



over-all accelerating potential applied to the tube is 29 kv. Under these conditions, writing rates as high as 400 in. per microsecond can be recorded.

The type 281 is designed for laboratory or field usage. Magnetic shielding is said to be so complete that the instrument may be operated in the vicinity of power buses, generators, and welding equipment.

•

Haymow Light

FOR DUSTY and mildly corrosive locations, the No. 159 haymow lighting fixture has been designed by Union Insulating Co, Inc, P. O. Box 351, Parkersburg, W. Va. It is recommended for 60-w lamp. Applications are barns, chicken houses, grain warehouses, or where the 1947 NEC does not require special fittings covered by Article 500.

Socket, cover and globe holder are made of molded Bakelite. Mounting holes fit standard 4-in. outlet box. Glass globe is standard wide mouth one-quart canning jar, which can be easily and economically replaced.

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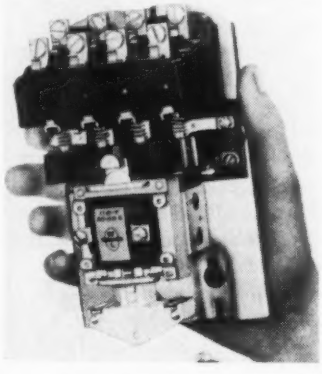
Solenoid Contactors

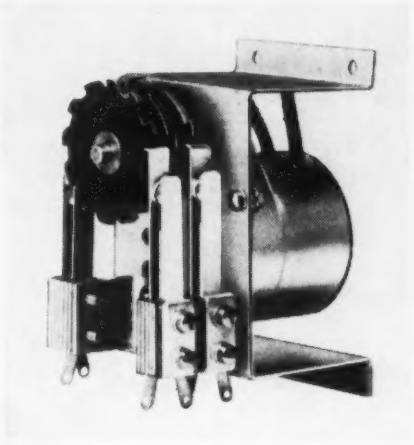
FIRST IN A NEW SERIES of control devices developed by Ward Leonard Electric Co, Mt. Vernon, N. Y., is the new



Bulletin 4451 Size 1 a-c solenoid contactors. Features include: Accessibility of all parts; rapid consistent operation; and high arc-interruption capacity.

Contactor parts are arranged on steel mounting plate having recommended NEMA mounting dimensions. They have double-break silver-to-silver contacts. The contacts are silver brazed directly to line and load connection terminals. Contactors are available with up to four main poles, and maximum ratings of 7½ hp, 440-550 v on 3-phase, 60-cycle circuits. Standard operation coils are obtainable for 110, 220, 440 and 550 v on frequencies of 25, 50 and 60 cycles.

Timer Control



BUILT by The R. W. Cramer Co, Inc. Centerbrook, Conn., the new Model VF timers are generally intended for built-in applications for automatic vending machines, dish washing machines, automatic laundry machines, and other types of equipment requiring time and sequence control. They are equipped with the synchronous motor Type SX and are available in a variety of speeds from 1 rpm to 1/24 rph.

The units have from 1 to 6 circuits for 6, 24, 110 or 220 v, 50 or 60 cycle. Contacts have a 10-amp rating and can be supplied in single or double throw. Dependent on applications, the contacts are either of the slow make or break, or with snap action.

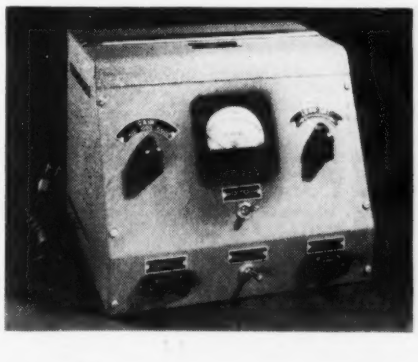
Over-all width of the timer is approximately 2½ in. and length 2⅝ in. The height is from 2½ in. for the single-cam unit to 3⅝ in. for six circuits.

•

D-C Amplifier

IN THE "MICROSEN AMPLIFIER," an instrument to measure and amplify minute power impulses as low as 0.2 microvolts, Manning, Maxwell & Moore, Inc of Bridgeport, Conn., has introduced a new principle in d-c amplification.

Power inputs from ionization, photoelectric cells, thermocouples, or a



Wheatstone bridge are amplified by means of an electro-mechanical balance, giving an output signal directly proportional to the input signal. The amplifier has an input circuit which is insulated from the output and ground. Input is measured and output stabilized through a feedback circuit. The instrument incorporates a mechanical zero adjustment with sufficient range to permit operation from various reference voltages, an adjustable gain, no lower frequency limit, and low input resistance.

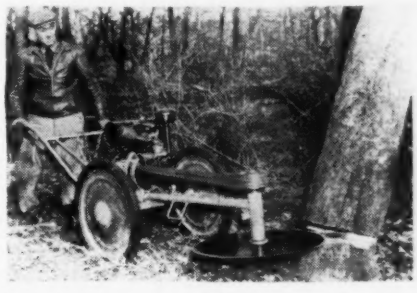
This new principle is said to permit a simplicity of design which can be manufactured at relatively low cost. Other features are: no extended warm-up period is required; standard tubes to commercial tolerances are used; and no tube matching is required.

•

Portable Clearing Saw

A MODEL 100 C-saw has been added to the line of portable engine-driven units manufactured by the Harry A. Lowther Co, 141 West Jackson Blvd, Chicago 4, Ill. It is suitable for such operations as right-of-way clearing, maintenance and logging.

The one man, two-wheel saw has a 6-hp engine and can be used with a 30-in. diameter blade with 60 teeth for cutting hard wood. It is equipped with a Rototrac, a friction drive from the engine to propel the saw at any speed by



throttle control. In addition an automatic clutch, mercury filled, engages the engine and blade drive when the throttle is open and disengages instantly when the throttle is closed or if saw blade pinches. Wheels are equipped with 2.5 x 26-in. pneumatic tires.

•

Intercommunication Systems

MASTER STATIONS having self-clearing piano-action keyboards are used with the Flexifone intercommunication systems developed by Operadio Manufacturing Co, St. Charles, Ill. The executive series (illustrated) can be used in combinations of master stations and

You get these 7 sales-compelling features to talk about!

7 important features of the new General Electric Automatic Electric Water Heater give you facts for a most convincing sales talk.

Read on—and see for yourself how they'll help you sell more heaters.

1. **Up-to-the-next-minute method of applying heat.** Held tightly against the tank by spring connections, the General Electric Heat-Wrap Calrod* conduction units apply heat by conduction at constant pressure. This gives maximum heating efficiency.

   And further—wattage substitutions and unit changes can be made quickly. You don't even have to drain the tank.

2. **Protection against tank corrosion.** An easily installed special magnesium-alloy tube lengthens tank life by helping to protect galvanized tanks from corrosive water.

3. **Complete warranty comes with heater.** If tank leaks develop within a year, General Electric will replace the entire heater. (5 years on Monel tanks.)

4. **Fiberglas blankets** insulate tanks on all sides . . . keep heat in water.

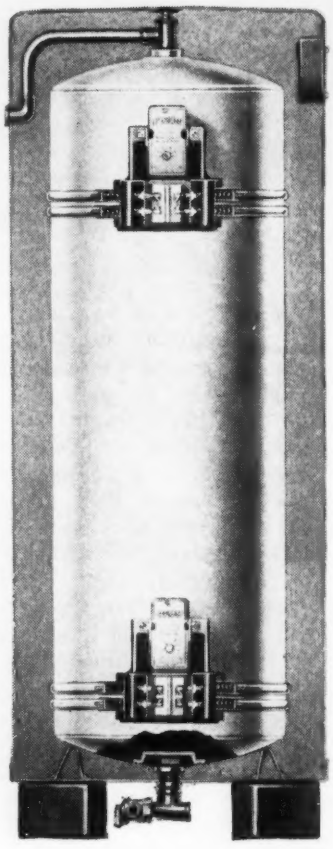
5. **Just two tank openings**—which means less chance of leakage.

6. **3600 kilowatt-hours** are added to your average domestic load each time you install a General Electric Water Heater on your lines.

7. **Every combination of wattages** is met by a maximum of 6 standard General Electric Units. Thus servicing and unit stocks are greatly simplified. General Electric Company, Appliance and Merchandise Department, Bridgeport 2, Conn.

   15-gallon to 82-gallon capacities—galvanized and Monel tanks.

*Trade-mark Reg. U. S. Pat. Off.



GET YOUR COPY TODAY!

Send for handy, tuck-in-your-pocket pamphlet that will help you answer those questions customers always ask.

Questions like, "What size tank should we use?" "How much water will my family use?"

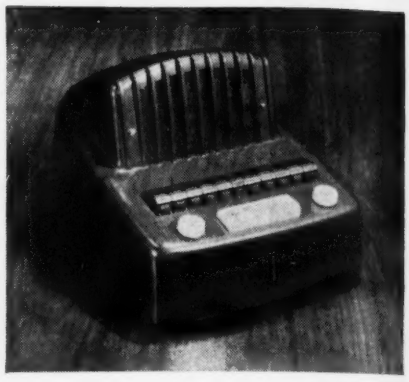
Space is provided for imprinting your size and water heating costs based on your local rates.

Ask at your General Electric Distributor's for a copy of *Answer All*. Better still, get enough copies for each of your salesmen!

AUTOMATIC ELECTRIC

WATER HEATERS

GENERAL ELECTRIC



speaker stations of 9, 10 and 20 units for two-way conversation. The supervisor series has selector switches for any one of six speaker stations. Stations have electronics equipment mounted in die-cast metal cases. Dimensions are 9¼ in. wide, 7¾ in. high, 11⅝ in. deep. Both executive and supervision series can be used in combination.

Speaker units provide talk-back communication and can include a call switch to originate calls to master station. Die-cast metal cases are 6¾ in. wide, 5⅝ in. high, 7⅞ in. deep, and weigh approximately 4 lb.

•

Panelboard

A NEW "PLUG-IN" PANELBOARD with thermal-magnetic Multi-breakers has been developed by Square D Co. 6060 Rivard St, Detroit 11, Mich. The narrow, column type is said to provide twice the number of circuits previously available in cabinets of similar size.

The "plug-in" feature permits easy and speedy removal or insertion of the small MO4 Multi-breaker units. The units are mounted on silver surfaced bus bars by positive-pressure contact jaws. The breaker units regularly provide four single poles which can be converted into two double poles by the insertion of handle ties.

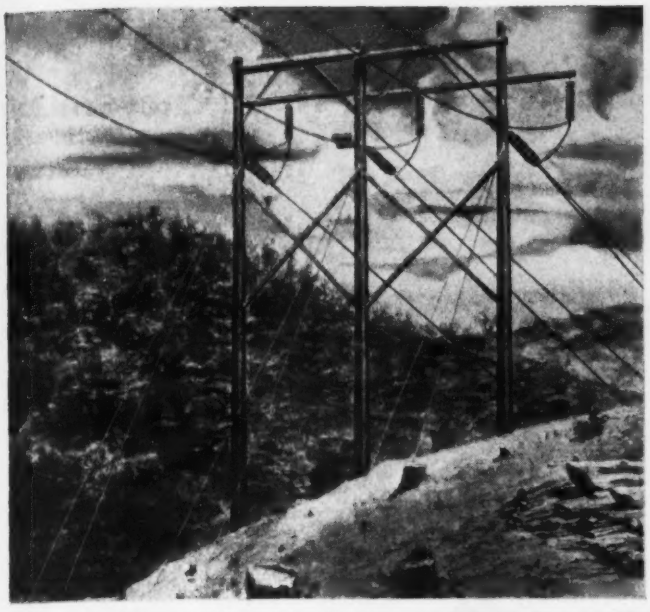
Type NMO panelboards are furnished in 100- and 200-amp mains ratings, 120/240 v, a-c, with 15-, 20- and 30-amp branch circuits.

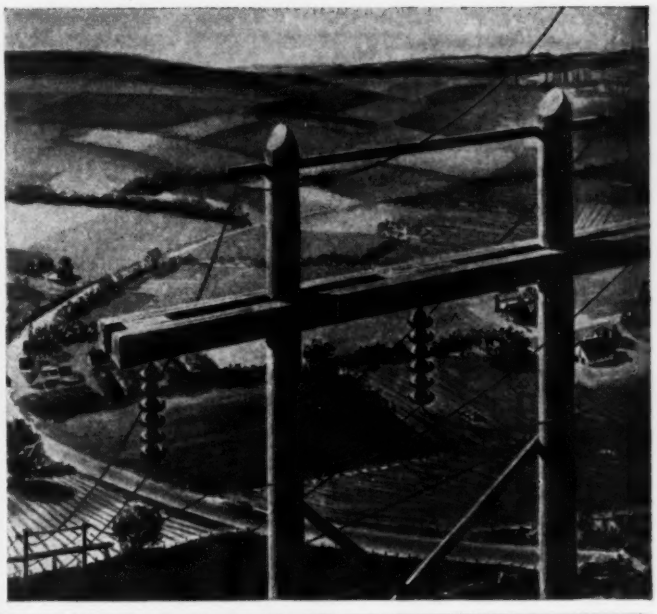
•

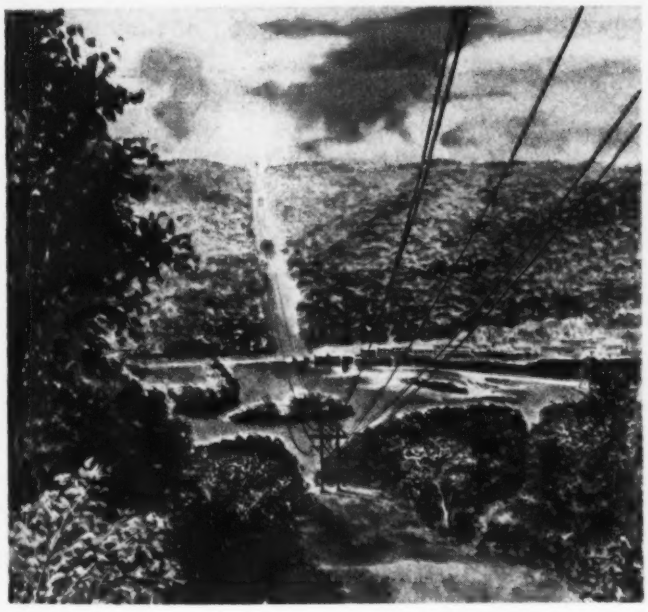
Gas Detector

FOR DETERMINATION of hazardous conditions due to presence of flammable gases or vapors, the Davis Emergency Equipment Co, Inc, 45 Halleck St. Newark 4, N. J., announces the new model 6 Vapotestor. The instrument has two ranges. One range analyzes combustible gases in terms of their lower explosive limit. A second scale indicates gases in their toxic range.

Basic principle of the indicator is the measurement of increases in the resis-







Regardless of DISTANCE or TERRAIN

Hoosier engineers and trained men are available to efficiently and economically supplement your own organization on any erection or maintenance job. If you are having difficulty meeting today's urgent demand for power . . . if you have a problem of time or manpower . . . Hoosier service can help you meet it.

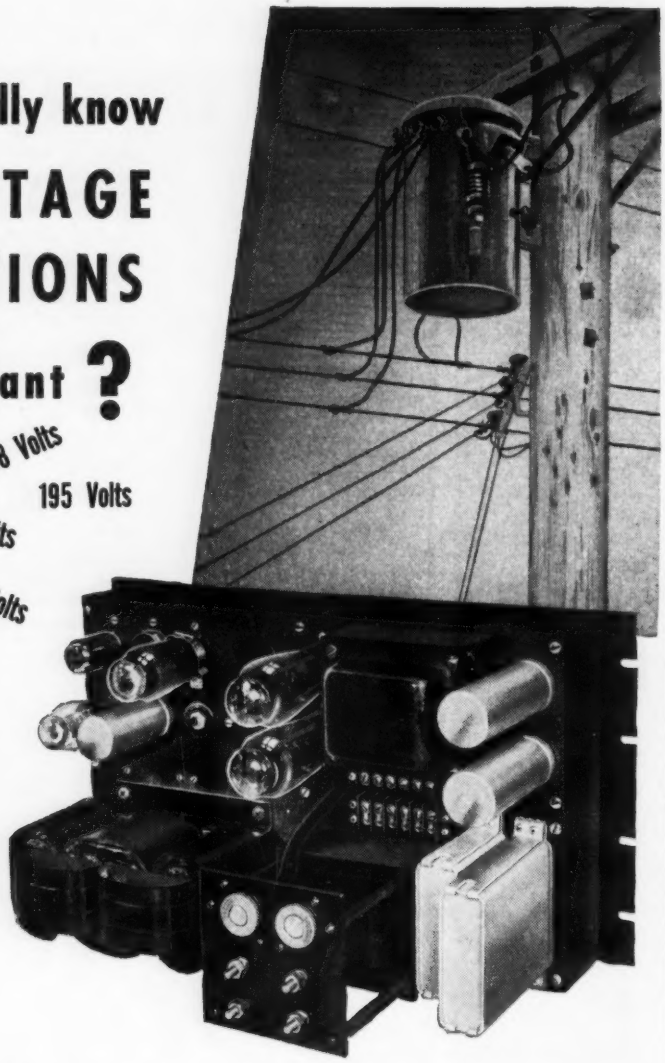
HOOSIER ENGINEERING CO.

ERECTION and MAINTENANCE OF TRANSMISSION LINES

NEW YORK 1384 HOLLY AVE., COLUMBUS, OHIO CHICAGO

Do you really know the VOLTAGE CONDITIONS in your plant ?

208 Volts
195 Volts
220 Volts
115 Volts
255 Volts



To correctly answer this question is difficult. Your utility may quote a nominal voltage . . . but, by law, most power suppliers have up to ±10% tolerance. This condition plus changing loads in your own plant results in voltages other than the nominal. Only by engineered control can you be sure that line voltage will remain constant.

With a STABILINE Automatic Voltage Regulator in the power line, your electrical apparatus is assured of constant voltage.

Type IE . . . these all-electronic regulators provide instantaneous action in maintaining the delivered voltage to within ±0.1 volts of the preset value regardless of line variations. For any load current change or load power factor change from lagging .5 to leading .9, type IE will hold the output to ±0.15 volts. Maximum waveform distortion never exceeds 3%.

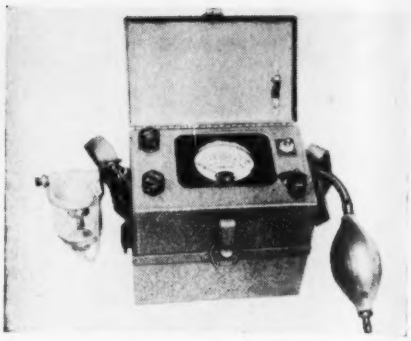
Type EM . . . for large size installations where low cost and high efficiency are paramount considerations but instantaneous action is not essential, type EM regulators find wide application. These units have zero waveform distortion; are not affected by changes in the power factor or magnitude of the load; and the regulator does not affect the power factor of the system.

Further information is available in Bulletin 547. Write for your copy.

Write SUPERIOR ELECTRIC, 1110 Laurel Street, Bristol, Conn.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

Powerstat Variable Transformers • Voltbox A C Power Supply • Stabiline Voltage Regulators.



tance of a filament when exposed to a gas or vapor-air mixture as compared with a filament not exposed to such gas or vapor-air mixture.

MORE NEW PRODUCTS
about which you should know

Miskella Infra-Red Co, Cleveland 4, Ohio has developed an 8-kw, 32-lamp **rack-tub** for preheating and baking operations in coating racks. . . . Nelpin Manufacturing Co, Long Island City 1, N. Y., has a **solder feeder** which clamps on an electric soldering iron and feeds solder by finger-tip control. . . . Hanson-Van Winkle-Munning Co, Matawan, N. J., announced the Cadux HS process, a bright cadmium **plating process** featuring tolerance for impurities.

Larkin-Lectro Products Co, New York 30, N. Y., has a portable combination **battery charger and arc welder** in two transformer models: 30-amp charger and 75-amp welder; and 10-amp charger and 55-amp power factor corrected welder. . . . American Gas Accumulator Co, Elizabeth 3, N. J., has an electro-pneumatic **time delay relay** with a hold-in switch that makes possible remote pushbutton control.

Neoline, Inc, Los Angeles 12, Calif., is marketing the Neolock "105" **locking pug** which has a wedge to force the plug prongs against the receptacle contacts. . . . C. J. Tagliabue Mfg Co, Brooklyn 5, N. Y., designed a 5¾-in. square temperature and time-operation **recorder** that is stated to resist shock and vibration.

Potter & Brumfield Manufacturing Co, Chicago 6, Ill., has developed a **mercury contact relay** for use in hazardous locations. . . . Guernet Electrical Machinery, Inc, Meriden, Conn., has designed a ⅓-hp, 115-v, single-phase, **reversible motor,** with speed adjustable from 1,500 to 6,000 rpm, controlled by lever and centrifugal vibrating contacts.

Cam-Stat, Inc, Los Angeles 34, Calif.,

VITROTEX *Magnet Wire*

WITH GLASS FIBER INSULATION

THAT'S SOFT AS SILK . . STRONG AS STEEL

TO WITHSTAND temperatures up to 130° C, Vitrotex magnet wire is insulated with alkali-free glass fibres. This inorganic textile is soft and luxurious—with a tensile strength comparable to that of steel. The servings are bonded with a high grade insulating varnish, to give Vitrotex a smooth abrasion and moisture resistant surface.

The excellent heat conductivity of its glass fibre insulation, high dielectric strength, resistance to moisture, acids, oils and corrosive vapors make Vitrotex the material for windings of superior quality. For further information on the complete line of Anaconda Magnet Wire, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y. 47470

WHY VITROTEX SERVES BETTER

1 *Withstands high temperatures*

2 *High dielectric strength and insulation resistance*

3 *Non-hygroscopic; Unaffected by moisture*

4 *High resistance to acids, oils and corrosive vapors*

ANACONDA
from mine to consumer

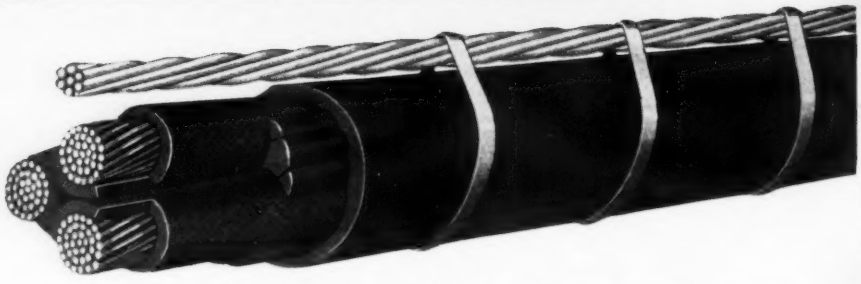
LOOK TO *Anaconda* FOR ENGINEERED MAGNET WIRE AND COILS

Collyer

SELF-SUPPORTED AERIAL CABLES AND NON-METALLIC UNDERGROUND CABLES

FOR ECONOMY • LONG LIFE DEPENDABILITY

AERIAL CABLE



Collyer Self-Supporting Aerial Cable is built for dependable service among the treetops — to stand the chafing of branches, and to maintain service during storms. With messenger and cable preassembled at the factory, installation is rapid under the most difficult conditions: and once installed, the necessity for tree trimming is greatly reduced. On Collyer Aerial Cable there's no lead to crack or fibrous coverings to festoon. The protective jacket of tough, long-lived neoprene, and conductors covered with efficient, corona-resisting oil base insulations make operation safe even when poles are down.

UNDERGROUND CABLE

Collyer Underground Cable has a very tough neoprene jacket which is highly resistant to moisture. It is built to stand abuse and resist abrasion. The cable has low dielectric constant and power factor; its oil base insulation is moisture-resistant and has excellent ageing properties. Having no lead covering, the cable is light in weight, easy to install, and economical to tap and splice. Type RR non-metallic underground cable may be installed in ducts or buried directly in the soil.

Write for complete information

Collyer INSULATED WIRE CO.

245 ROOSEVELT AVE., PAWTUCKET, R. I.

has a type CD107 automatic electric **water heater control** rated 3 kw, 240 v a-c; temperature range of upper and lower thermostat is 60 to 190 F. . . . Thwing-Albert Instrument Co, Philadelphia, 44, Pa., has an electronic percent **moisture meter** which weighs the material and then measures its electrical resistance. . . . Palo-Myers, Inc, New York 7, N. Y., has a 110-v a-c **clock-operated switch** with dial and double-pole contacts for 20-amp noninductive loads.

Continental Electric Co, Hawthorne, Calif., introduced an adjustable 3-phase **winding head** model D for coils for ⅛- to 40-hp motors. . . . Potter Instrument Co, Flushing, N. Y. makes a model 450 **electronic timer** to measure intervals in steps of 0.625 microsecond and register intervals up to 1 sec.

Aircraft-Marine Products, Inc, Harrisburg, Pa., developed a **footpress** for installing solderless wiring terminals. . . . Agnew Electric Co, Milford, Mich., has developed a four-station **electric heater** for high-speed heating of metals prior to forging or hot-upsetting operations.

Stevens-Arnold Co, South Boston, Mass., has a double-contact **polarized relay** assembled in a metal radio tube container and said to operate mechanically in ⅓ millisecond. . . . National Technical Laboratories, South Pasadena, Calif., announces a model H portable glass electrode **pH meter**, readings 0 to 14 pH and 0 to plus or minus 410 millivolts, operates on 110-v, 50/60-cycle circuit. . . . Warsaw Elevator Co. Warsaw, N. Y. has introduced an **elevator drive** with a fluid coupling between motor and worm gear, and simplified control.

Allied Control Co, New York 21, N. Y., has a small **relay**, $1\frac{13}{32}$-x$1\frac{5}{8}$x$1\frac{7}{8}$ in. for either a-c or d-c coil operation and with double-break contacts rated 15 amp. . . . W. T. Driver, Minneapolis, Minn., has fabricated electric switch and **outlet boxes** from aluminum, reported to have UL and REA approvals. . . . Piqua Machine and Mfg Co. Piqua, Ohio, has a Vibratol **motor** which is is an a-c vibrator driving upon a "one-way" clutch, built for 115-v, 60-cycle service.

All-State Welding Alloys Co. Inc, White Plains, N. Y., has available a silver-brazing **alloy dispenser** made of aluminum, its center being recessed to carry the flux jar. . . . Aeroil Products Co, West New York, N. J., made available electrically heated, thermostatically controlled, melting and **dispensing tanks** for wax and battery and transformer compounds. . . . Rumac Manufacturing Co, New York 10, N. Y., have 3-ft and 5-ft lengths of Flex-O-Tension shafts for use with power-driven screwdrivers.

NEWS ABOUT PEOPLE

Nelson Made Vice-President of New England Utilities

Rufus L. Nelson has been elected vice-president of the Bellows Falls Hydro-Electric Corp and Connecticut River Power Co. He will make his head-

R. L. NELSON

quarters at Concord, N. H., in new offices opened in the Patriot Building by these companies.

A graduate from the University of New Hampshire, after service in World War I, he was employed by the Utica Gas & Electric Co. In 1928 he joined New England Power System and was placed in charge of conducting an industrial survey of the state of New Hampshire. In 1930, upon completion of the Comerford Station at Fifteen Miles Falls, the construction of which prompted the survey, Mr Nelson transferred to the power sales department at the Boston office in charge of industrial development.

In 1936 he was appointed executive assistant of United Electric Railways Co and was elected vice-president in charge of operations of that company in 1943. After a short connection with the Worcester Street Railway Co, he returned to New England Electric System as executive assistant, the position he held until his recent promotion.

•

▶ LYMAN B. BRAINERD has been elected president of the Hartord Steam Boiler Inspection & Insurance Co. He succeeds Curtiss C. Gardiner, who has retired on account of ill-health. Mr Brainerd joined the company in 1930. He became superintendent of agencies and a director in 1942, later that year becoming vice-president. FRED S. CAMPBELL, manager of the company's New York office, has been appointed vice-president in charge of the agency department. He entered the employ of the company in 1932 at Chicago.

•

M. F. Beebe Assumes New Operating Duties with UI

United Illuminating Co, New Haven, Conn., has recently announced changes in the company's operating organization.

Marshall F. Beebe has been appointed superintendent of operations in charge of the company's production and distribution departments. Edward H. Walton continues as superintendent of distribution, reporting to Mr Beebe. Paul V. Plummer has been named su-

M. F. BEEBE

perintendent of production and Edward H. Walton has been made assistant superintendent of production.

Mr Beebe entered the employ of the company in a sales capacity in 1916 and later transferred to the distribution department to check line extensions. He successfully handled one responsible position after another in the distribution department, resulting in his appointment as superintendent of distribution for the New Haven division in 1939. Previous to his recent appointment, Mr Beebe was superintendent of production in charge of the company's Bridgeport and New Haven generating stations.

James M. Woodmansee Given Vice-Presidency

James M. Woodmansee, assistant to the president of the Electrical Engineers Equipment Co, Melrose Park, Ill.,

J. M. WOODMANSEE

and in charge of that organization's production facilities, has been appointed a vice-president of the company. In his new position, Mr Woodmansee will take a more active part in policy formation and in over-all company management. He will also continue with his former duties.

Mr Woodmansee became associated with the company in 1934, serving at first in the manufacturing departments and later in other departments. Entering the U. S. Navy in 1943, he was assigned to electronic work. After extensive training at the Navy Pier, Chicago, and at the Oklahoma Agricultural and Mechanical College, Stillwater, he was sent to the Pacific theatre, serving in the Philippines and other points. For several months he was with the U. S. occupational forces in Japan.

Again associating with Electrical Engineers Equipment Co following his discharge from the service in 1945, he was subsequently appointed assistant to the president and elected to the board of directors.

•

▶ EDWARD M. PAULLIN has resigned from the Worthington Pump & Machinery Corp after 16 years of service to form the Paullin Equipment Co, Inc, Buffalo, N. Y. The new organization will deal in new and rebuilt mechanical

IT'S COMPACT
IT'S POWERFUL

It's the NEW COFFING "MIGHTY-MIDGET" PULLER

WEIGHS 6½ lbs. PULLS 500 lbs.

Use the *new* "Midget" Puller to save time and strength on scores of jobs in utility and electrical construction and maintenance. One of the most compact, versatile tools ever made for tightening wire, tensioning guys, lifting equipment. 500 lb. capacity on lift or pull, requiring only 28 lbs. of effort at maximum load. Snaps on lineman's belt. Two-way "Safety-Load" handle serves as lever or high speed crank. Ask for Bulletin EMP-1.

Other Coffing Products: The HOIST-JACK • SAFETY-PULL HOISTS • ELECTRIC HOISTS • SPUR-GEARED HOISTS • LOAD BINDERS • TROLLEYS

COFFING HOIST COMPANY
DANVILLE, ILLINOIS

SAVINGS in . . .

Time, Current, Money . . with

TRICO Powder-Packed FUSES

Here's a fuse that's DIFFERENT. You get Double Protection plus THREE TIMES THE SERVICE. With TRICO fuses you eliminate unnecessary shut-downs, wasted current and time. Nothing has been spared to make TRICO FUSES outstanding in performance and lasting service.

Check These Advantages:

- Tamper-proof Protection
- Non-interchangeable link
- Life-time outer parts
- Fire & accident protection
- Guaranteed results.

RENEWAL ELEMENT

It's *Different*
It's *"Powder-Packed"*

TRICO'S famous custom-built, "Powder-Packed" renewal element Protects The Link . . . Supports The Link . . . Chokes arc and hot flashes . . . Creates emergency Time-lag . . . Absorbs explosive pressures . . . Acts as a heat insulator.

WRITE FOR FREE #206-A BOOKLET

TRICO FUSE MFG. CO. Milwaukee Wisconsin FUSES

and electrical equipment. In addition to reconditioning compressors and vacuum pumps, the company will act as consulting engineers and manufacturers' agents. Other officers in the company are JOHN H. DARBY, vice-president and GLENN A. IRVIN, secretary. While associated with Worthington, Mr Paullin served as assistant manager of the compressor division. Previously he was connected with the General Electric Co, Schenectady.

•

Payne Heads Westinghouse Industry Sales Units

John E. Payne, formerly manager of industrial sales, has been named manager of all industry sales departments

J. E. PAYNE

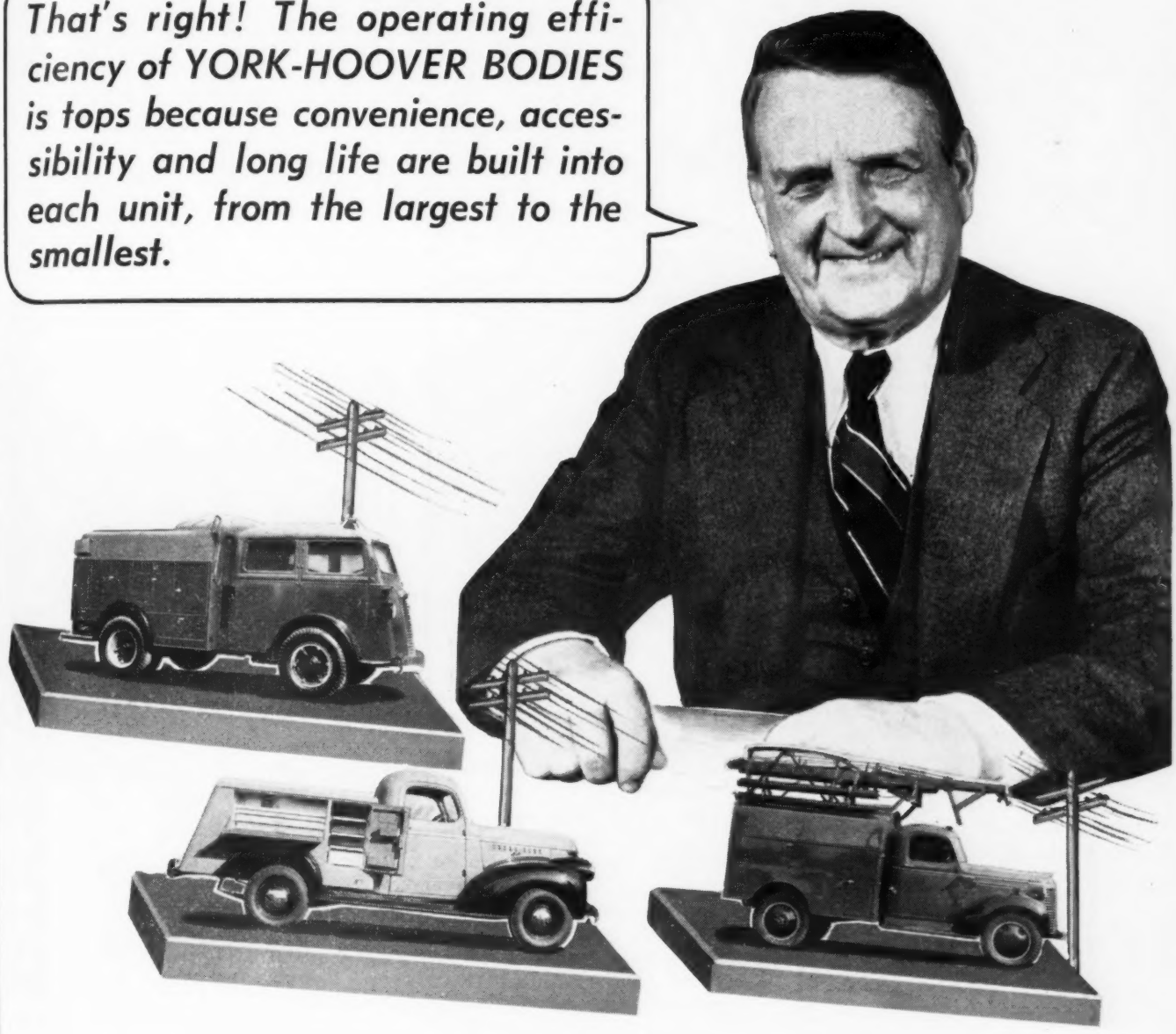
for the Westinghouse Electric Corp, with general over-all responsibility for sales of equipment to all industries. R. S. Kersh, who has been manager of the company's Houston, Tex., office since 1942, was named manager of industrial sales to succeed Mr Payne. Both men will be located at the East Pittsburgh, Pa., plant.

Mr Payne joined Westinghouse immediately after graduation from the Alabama Polytechnic Institute in 1925. After a year on the company's student training course, he went into the general engineering department. He served as an industrial salesman in the Pittsburgh office for almost six years before he was named manager of industrial sales for the central district. He remained in that position until early this year when he was made industrial sales manager. Mr Payne is a member of the Engineers' Society of Western Pennsylvania.

Mr Kersh's entire business career has been spent with Westinghouse. After completing the Graduate Student Course, he served in Atlanta and Birmingham before he entered the resale machinery section in East Pittsburgh. His assignment to Houston followed.

Tops in Operating Efficiency!

That's right! The operating efficiency of YORK-HOOVER BODIES is tops because convenience, accessibility and long life are built into each unit, from the largest to the smallest.



For over fifty-five years, ever growing experience plus top quality materials and fine craftsmanship have been the basic factors contributing to the reliable performance of York-Hoover Bodies . . . factors, too, that have earned and maintained the valued confidence of our customers.

YORK, PENNSYLVANIA

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Indispensable
for engineers working with control equipment

MAGNETIC CONTROL of INDUSTRIAL MOTORS

By GERHART W. HEUMANN

Administrative Assistant, Control Engineering Division, General Electric Company

This book is designed to aid in understanding the application of controllers to industrial motors. It presents a clear, comprehensive treatment of the characteristics of control devices, the function of commonly used control circuits, and what performance can be expected of various types of motors.

MAGNETIC CONTROL OF INDUSTRIAL MOTORS is written in easily understood language, with a minimum of mathematics. The basic material is well-arranged and presented, with clear, concise explanations, and a wealth of cuts and circuit diagrams. Among the topics discussed are: complete controllers of various frequently used designs, external motor characteristics, rating and selection of control devices, basic magnetic devices such as contactors and relays for direct and alternating-current, manual versus magnetic control, basic amplidyne control circuits, electronic control devices, maintenance of control equipment, and fundamentals of motor performance and circuit layout.

Nov. 1947	Approx. 593 Pages	Probable Price $7.50

FREE EXAMINATION COUPON

JOHN WILEY & SONS, INC EW-11-47
440 Fourth Ave., New York 16, N. Y.

Please send me, for ten days' FREE EXAMINATION, a copy of Heumann's MAGNETIC CONTROL OF INDUSTRIAL MOTORS. If I desire to keep the book, I will remit price plus postage; otherwise I will return the book postpaid.

Name .....
Address .....
City ..... State .....
Employed by .....
(Offer not valid outside U. S.)

Mr Kersh is a member of the American Institute of Electrical Engineers and the National Society of Professional Engineers.

•

Owens-Corning Makes New Executive Appointments

John H. Thomas has succeeded George E. Gregory as vice-president and purchasing director of Owens-Corning

B. S. WRIGHT

Fiberglas Corp, Toledo, Ohio, and Ben S. Wright has become Owens-Corning's general sales manager. These changes were announced by Harold Boeschenstein, Fiberglas president, following the resignation of Mr Gregory to become president of the Morton-Gregory Co, Inc, recently organized.

Mr Thomas has been Owens-Corning's vice-president in charge of sales since 1946. He has been with the organization since it was organized in 1938.

Mr Wright joined Owens-Corning in 1940 and was assigned to the general office sales organization as manager of the Fiberglas yarns division. In 1945 he became manager of the Fiberglas branch sales office in Cleveland and returned to the company's general offices in Toledo this summer.

Mr Gregory was one of the original pioneers in the commercial development of the Fiberglas Corp. He went to Owens-Corning from Corning Glass Works in 1938, serving successively as general sales manager, director of sales and then vice-president.

•

▶ FREDERIC W. BLISS, for the past 19 years New England district manager of advertising and sales promotion for the General Electric Co, Boston, has retired. He has been appointed a member of the Massachusetts Labor Relations Commission for a five-year term, effective immediately. The commission is responsible for administration of the

GREATER SAFETY *for* **Linemen** *with* **KEES Hold-Card HOLDER**

Holds warning cards. Protects them against removal, loss, and weather-damage. Steel case with plate-glass window. Attaches to high voltage switch rod or structure.

Write or Free Kees Catalog of boxes for letters and instrument transformers, outlet box hangers, holdcard holders, conduit straps, etc.

KEES

F. D. KEES MFG. CO.
BOX 647
Beatrice, Nebraska

UNDER THE GROUND PROTECTION

Cope

GROUND TENTS

To give your ground crews *indoor* working conditions *out-of-doors* provide them with Cope Ground Tents. They are insurance against wind, rain and sun—the hampering effects of the elements!

The Cope Ground Tent stands 6' 9½" square and 6' 5" high with an additional flap 1' 3½" wide extending all around the manhole for added ground coverage. The frame of extra heavy pipe is completely welded and galvanized. The tent, of 10-oz. U. S. Army duck, will withstand plenty of hard use. For ease of handling and storage the complete unit folds into a compact bundle.

For an *outdoor efficient* workplace—"snug as a bug in a rug"—equip your crews with Cope Ground Tents!

It Pays To Specify Cope

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CABLE INSTALLATION & MAINTENANCE TOOLS & EQUIPMENT

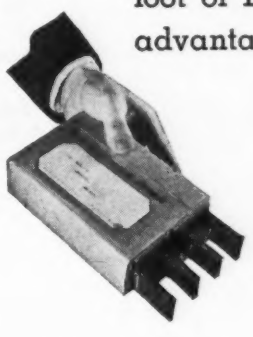
state labor relations act. Mr Bliss joined General Electric in 1905, spending five years at the Harrison (N. J.) Lamp Works. He then was transferred to the Providence office, becoming manager of lamp sales in southeastern New England. In 1928 he became located at Boston and apart from his promotional work for the company has been prominent in industry affairs and civic movements of wide scope. For three terms he was president of the Engineering Societies of New England, Inc. He is a past president of the Providence Engineering Society and was a trustee of the Electric Lighting Institute of Brown University.

▶ GROVER S. TRACY has been appointed manager of the San Francisco division of the Pacific Gas & Electric Co, succeeding Norman R. Sutherland, who has been promoted to vice-president in charge of public relations and sales. Mr Tracy, a veteran of 41 years service with PG&E, has been assistant manager of the San Francisco division since 1945. He joined the company as a service clerk. On his return from France after World War I, where he served as an artillery lieutenant, he was successively superintendent of gas sales, chief clerk of gas and electric sales, manager of the division service bureau and division office manager. He has been president of PG&E's non-profit Employees Credit Union since its inception in 1936.

▶ RALPH G. RAYMOND, manager of electricity sales for the Commonwealth Edison Co, Chicago, has been elevated to the grade of fellow of the Illuminating Engineering Society in recognition of his outstanding contributions to the promotion of the science of illumination and the interests of the society. Rudolf W. Staud, national president of the society, presented the certificate of fellowship to Mr Raymond at the October meeting of the Chicago section. Mr Raymond is a former chairman of the Chicago section and has served on numerous important national committees of the society.

▶ FRED J. WALTERS, JR, has been named manager of industrial relations, Hotpoint, Inc, a newly created position that includes responsibility for personnel and community relations at all plants. Mr Walters has been industrial relations staff officer for all affiliated General Electric companies, and goes to the Hotpoint staff from General Electric X-Ray Corp where his functions as vice-president included employee and civic matters. Two personnel changes designed to gear Hotpoint's merchandising program to meet greatly expanded

They checked and found that every square foot of Blaw-Knox Steel Grating has these advantageous features:



1. *One-piece* electroforged construction develops the full strength of all sections of metal used in manufacture.
2. *Maximum Open Area* for light and ventilation.
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5. *Safe* footing at all times due to twisted cross bar.

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EBASCO accounting consultants are prepared to assist you with organization surveys and studies of your customer billing and accounting methods, general accounting procedures, budgetary control systems, etc., for the purpose of cost reduction.

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SERVICES OFFERED—Accounting • Appraisal • Budget • Consulting Engineering • Design & Construction • Financial • Industrial Relations • Inspection & Expediting • Insurance • Purchasing • Rate & Pricing • Research • Sales & Marketing • Tax • Traffic

productive capacity were also announced. HOLLIS C. DOSS, formerly Kansas city sales manager for the appliance division of Enterprise Wholesale, Inc, has been made manager of the kitchen sales division for Hotpoint and FRANK L. SACHA, formerly executive representative for the company in Washington, D. C., has been named manager of Hotpoint's newly created water heater division. Both men will have headquarters in Chicago. SELMA M. ANDREWS has been named director of Hotpoint Institute, appliance research and test center and use-value training headquarters. Mrs Andrews was formerly with Crosley division, Avco Manufacturing Corp.

▶ LEE H. POE has been appointed manager of the Central Arizona Light & Power Co's newly organized central division, which takes in gas and electric services in the Phoenix metropolitan and suburban areas. In addition to his duties as division manager, Mr Poe also will serve as district manager for Phoenix. He formerly was superintendent of the electric department.

The central division is the fourth such unit to be set up under the utility's divisional operating plan. Divisional heads will handle liaison work of day-to-day operational problems with department heads. Mr Poe joined the company in 1941.

OBITUARY

▶ IRA C. COPLEY, former utilities executive and a Republican member of Congress for twelve years, who published a number of newspapers in Illinois and California, died on November 2 in Aurora, Ill., his home town. He was 83 years old. An Illinois farm boy, Mr Copley was brought to Aurora by his parents. He was graduated from Yale University in 1887. Two years later he was graduated from Union College of Law, Chicago, and started a utility career. First he became manager of the Aurora Gas Light Co. In 1905 he consolidated several electric and gas companies and formed the Western United Gas & Electric Co of which he became president. Later when the company expanded to serve the outskirts of Chicago, its name was changed to Western United Corp and he served as president of the new company until it was sold to the Insull interests in 1926. Mr Copley owned only three Illinois newspapers when he left the utility business, but at the time of his death he was chairman of the board of Copley Press, Inc, which controlled five papers in Illinois and twelve in California, the latter acquired in 1928.

John H. Pilkington

John H. Pilkington, assistant to the purchasing agent of Consolidated Edison Co of New York, Inc, whose death

was announced in ELECTRICAL WORLD, November 15, page 20, entered the utility field in 1923 when he joined the former Brooklyn Edison Co, now a part of Consolidated Edison. Serving as a technical assistant in the outside plant bureau of the electrical engineering department, Mr Pilkington continued with Brooklyn Edison until 1936, when he transferred to Consolidated Edison as manager of the technical bureau in the technical development and research department. Later he was assigned to the system engineering department, where he remained until last year when he was appointed to the position he occupied at the time of his death.

Mr Pilkington was called to Washington twice during the war emergency. In 1942 he went to the capital to serve as consultant to the National Defense Research Committee, most of his work in this connection being performed for the War Department at Aberdeen, Md. In 1944 he was summoned a second time as power engineer in the Office of War Utilities, WPB.

For a number of years he was active in the American Institute of Electrical Engineers. At the time of his death he was a member of the sections committee and a past-chairman of the New York Section, of the National Membership Committee and of the power division, New York Section.

Mr Pilkington was born in Highmore, S.D., in 1898 and was graduated from the University of Michigan in 1922.

•

▶ ARCHER B. CROUSE, since 1925 head of the system operating department of the Dayton (Ohio) Power & Light Co, died recently at the age of 59. Mr Crouse became associated with the Day-

ton utility in 1915, working in electrical construction. Two years later he was appointed working foreman at the then Miller's Ford Plant, doing construction work for the installation of the new station generators. It was in 1925 that he was selected to head up the newly organized system operating department. Mr Crouse was an active member of the executive committee of the Radio Technical Planning Board, serving as vice-chairman. He was also secretary of the Northwest Interconnected Regional Committee. Mr. Crouse was born in West Alexandria, Ohio.

▶ WILLIS HALL, 63, superintendent of the Ellensburg, Wash., light and water department for 22 years until his resignation in 1943, died recently at McMinnville, Ore., where he had gone for medical treatment. He was widely known in Pacific Northwest power circles.

▶ WILLIAM J. MURDOCK, 78, founder of the company bearing his name at Chelsea, Mass., and a pioneer in the manufacture of electrical communication equipment, died in that city on November 9. He organized the company in 1904, and was well known in electrical manufacturing circles in the East.

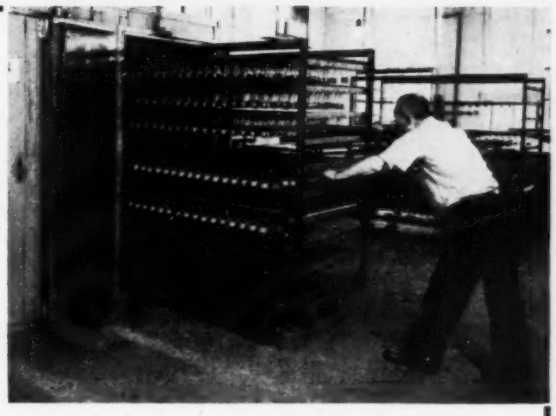
▶ CHARLES W. HENDERSON, head of the department of electrical engineering at Syracuse University until his retirement last May, died on November 3 at his home in Syracuse, N. Y. He was born in Bradford, Pa., 63 years ago.

▶ ANGUS F. MERRILL, 56, an electrical engineer employed by Sylvania Electric Products, Inc, Danvers, Mass., died at Wenham, Mass., on October 13.

▶ L. F. RANDOLPH, of the RCA Equipment Tube Sales organization, died on September 15 after an illness of several weeks. Mr Randolph had been with RCA for 17 years.

ACME MEMO TO Production Engineers

responsible for the manufacture of motors, transformers and coil windings



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Simplify Maintenance
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Subox, Inc.
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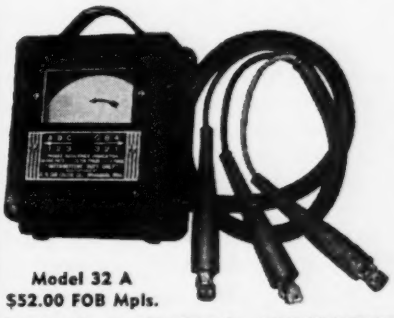

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50 to 600 volt, 25 to 120 cycles, 2, 3, or 6 phase

- The SELCO Indicator gives you quick positive readings. Avoids costly mistakes.
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A high grade fibre board for electrical insulation. A material of quality possessing high tensile and dielectric strength. Used by many of the leading manufacturers of electrical equipment.

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An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

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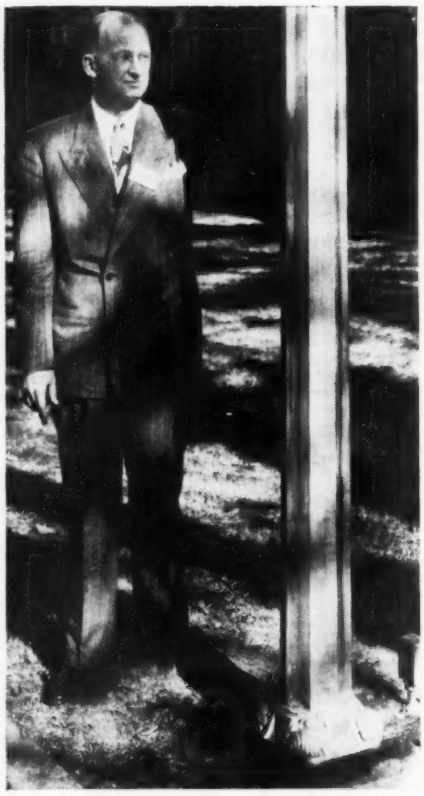
MANUFACTURERS & MARKETS

Manufacturers Announce Plant Expansion Plans

Century Electric Co, St. Louis, has awarded major contracts for the construction of a three-story and basement, 66 x 76-ft building to be erected on the south side of Olive St, between 18 and 19 Sts just north of Union Station. Earlier in the year Century Electric awarded contracts on a six-story and basement, 75 x 130-ft building and a five-story, 109 x 180-ft top addition to an existing building at the northeast corner of 19th and Chestnut Sts. That project, approximately $900,000 overall, is now under construction.

Carrier Corp has announced the acquisition of title to the huge plant at Syracuse, N. Y., that was built by the U. S. Navy in 1942. The purchase was made from War Assets Administration as a part of Carrier's $12,000,000 expansion program for the manufacture of air-conditioning and refrigeration equipment. The principal structure is a single-floor, high-bay building, which covers more than 13 acres under a single roof. This will provide Carrier with an additional 600,000 sq ft of production space. "We believe that we have acquired one of the finest industrial properties in the country, especially for the manufacture of heavy machinery," Cloud Wampler, president of Carrier, said. Upon accepting title to the property at a ceremony with WAA officials, he stated that the bulk of Carrier's heavy production will be moved to the new plant. Thus the older Syracuse property of the corporation will be used chiefly for expanded light manufacturing purposes. Located on Carrier's Thompson Road property, in addition to the principal structure, are a power house, a million-gallon water reservoir, huge standby oil and storage tanks, office building, garage, etc. The principal building is 924 ft long by 621 ft wide.

The new $100,000 Fowler Manufacturing Co building in Portland, Ore., has been placed in full use, according to Sales Manager Fred A. Fowler, son of President Paul L. Fowler. Located across the street from the main Fowler plant in Portland, the new structure will add 24,000 sq ft of floor space to the more than 60,000 already in use. This will increase materially the manufacturing capacity of the company, Mr Fowler said. Manufacture of electric water heaters by Fowler was consolidated in Portland when the company occupied its streamlined white stucco building in 1945. Prior to that it had operated with two factories, one in Portland and one at Spokane, Wash.



FIRST all-aluminum lamp post ever to be offered commercially was introduced by L. F. Heckman, sales manager, Union Metal Manufacturing Co, Canton, Ohio, at recent street lighting conference at Nela Park

Permanente Metals Corp started reduction operations October 31 in its recently purchased Tacoma, Wash., plant, adding 3,500,000 lb of aluminum pig per month to the company's production potential. With the first of two potlines in operation, the company began drawing on a Bonneville Power Administration contract for 44,000 kw. The plant has been ready for operation since the completion of some $1,000,000 worth of remodeling work last April, but opening of production waited availability of power from a new generator at Grand Coulee Dam, installation of which was completed late in October. The plant was built during the war and purchased by Permanente from WAA last December for $3,000,000. Aluminum pig from the Tacoma plant will be shipped to the firm's Mead rolling mill near Spokane.

•

A-C Earns 76c a Share in 3rd Quarter of 1947

Allis-Chalmers Manufacturing Co has reported net income for the third quarter of 1947 of $1,910,862 or 76 cents a share on common stock after provisions for federal income taxes and preferred dividend requirements.

Net income for the first nine months of 1947 totaled $1,807,810 or 72 cents a share on common stock after provisions of $1,860,000 for federal income taxes and preferred dividend requirements.

Provisions for federal income taxes during the second and third quarters of 1947 were necessarily estimated due to the effect thereon of the loss for the first three months of 1947, and for this reason the net earnings per share of common stock, after provisions for federal income taxes and preferred dividend requirements, in the second quarter and the third quarter of 1947 are not comparable in all respects. In this connection it can be stated that the profits applicable to the common stock (before provisions for federal income taxes but after preferred dividend requirements) were $1.08 per share for the three months ended June 30, and $1.36 per share for the three months ended September 30, 1947. For the nine-month period ended September 30, 1946, the company reported a net loss of approximately $17,425,000 before preferred dividend requirements and before credits for recovery of prior years' federal taxes under the carryback provisions of the Internal Revenue Code.

Billings in the third quarter of this year totaled $57,643,339 as compared with billings of $12,217,412 in the third quarter of 1946. For the first nine months of 1947 the company's billings

GREGORY TRANSFORMERS
IN VOLUME PRODUCTION

New GREGORY Type HE Continuous Duty 55° Rise 2400 Volt Primary 120/240 volt Secondary Single Phase 60 Cycle Oil Immersed Self Cooled Outdoor Distribution Transformers. Complete with New Transformer Oil and Standard NEMA Accessories.

These Transformers are all new—manufactured complete by GREGORY ELECTRIC to strict specifications in accordance with NEMA, EEI, and AIEE requirements.

GREGORY designed Transformers incorporate the use of the finest materials available, Low Core loss, and High Electrical efficiency. Transformers are furnished in round, heavy-gauge, steel tanks suitable for pole or platform mounting, with Pocket Wet Porcelain Solderless Stud Type Primary and Secondary Bushings.

Transformers 15 kva to and including 50 kva furnished without Taps. 75 kva and larger furnished with full capacity Taps as follows: 120/240 volt Secondary four 2½% below normal voltage. At 240x480 volt Secondary two 2½% above and two 2½% below normal voltage.

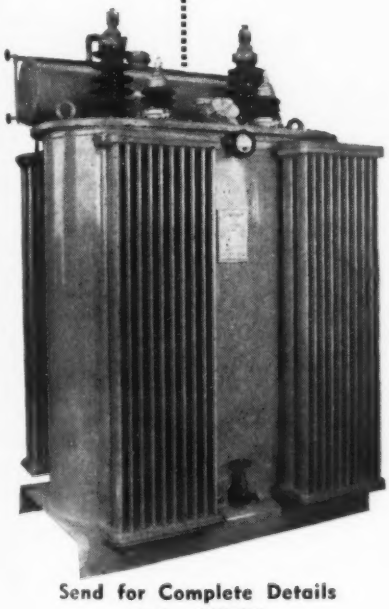
NEW GREGORY TRANSFORMERS

Production facilities and material on hand permit us to definitely assure deliveries of the following Transformers for March 1948.

QUANTITY	SIZE
200	15 kva
500	25 kva
250	37½ kva
400	50 kva
150	75 kva
100	100 kva
75	150 kva
75	200 kva
30	250 kva
15	333 kva
9	500 kva

NEW GREGORY HI-GRADE TRANSFORMERS

●Customers placing their orders early for monthly transformer deliveries will be in a position to procure their full requirements from GREGORY.



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Order NOW!

SPECIAL NOTICE

For those customers requiring indoor Transformers, GREGORY ELECTRIC is manufacturing large Power and Distribution Transformers 80°C Rise Cooled Insulated Dry Type Indoor Units in sizes to 2500 kva Single or Three Phase and Primary Voltages from 440 to 23,000.

All units are designed for Self Cooling, wound with inorganic materials, such as Mica, Fiberglas, Asbestos, etc. They are inclosed in modern all Steel constructed Drip Proof Tanks.

Send for complete specifications—list your needs—Our engineering staff is at your service.

3 K.V.A. Gregory Rural Conventional Distribution Transformer 7200/12,470 Y Volt Primary, With Standard Taps, 120/240 Volt Secondary, Single Phase, 60 Cycle.

Gregory Rural Distribution Transformers are approved by the Rural Electrification Administration, Washington, D. C.

We invite your inspection of our facilities in Chicago.

All transformers manufactured by Gregory Electric Company are thoroughly tested in conformance with A.I.E.E. and covered by an ironclad liberal standard one year guarantee.

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Allentown, Pa.
Alexandria, Va.
Scranton, Pa.
Glenburnie, Md.
Silver Springs, Md.
Charlotte, N.C.
Clearwater, Fla.
Erie, Pa.
Greensburg, Pa.
Pittsburgh, Pa.

LINE CLEARING

were $142,530,234 as compared with $64,184,527 in 1946.

Unfilled orders on September 30 of this year amounted to $160,000,746 as compared to the 1946 amount of $89,587,474.

•

Manufacturers Issue Earnings Report

Among the electrical manufacturing companies that have recently issued reports on earnings are the following:

MINNEAPOLIS-HONEYWELL REGULATOLR—Six months ended June 30, net income $3,302,343, equal, after preferred dividends, to $2.51 a share on the 1,243,800 shares of common stock outstanding. Net income for the half-year period a year ago was $1,630,666 or $1.18 a share. For the quarter ended with last year, net income was $1,493,828 or $1.13 a common share, against $977,707 or 72 cents a common share in the 1946 period.

AMERICAN INSULATOR — Six months to June 30, net income, $196,716, equal to $1.77 each on 108,210 common shares, compared with $83,260 or 78 cents each on 98,525 shares last year.

HOLOPHANE—Year to June 30, net income, $554,689, equal to $5.63 a common share, compared with $275,567 or $2.80 a share for previous fiscal year.

FLORENCE STOVE—Nine months, net profit, $1,027,882, equal to $2.98 a share, against $202,130 or 59 cents a share last year. Sales totaling $14,783,362, of which $9,216,168 were made to dealers, jobbers and others and $5,567,194 were made to Sears, Roebuck & Co. Total sales for 1946 period were $7,159,150.

GENERAL CABLE—Nine months, net income, $4,627,400, increased from $1,333,719 earned in 1946 period, when work stoppages occurred at five of the company's plants during early part of that year.

BLAW-KNOX—Net profit for third quarter of 1947 after taxes $842,238, equal to 62 cents a share, compared with $688,741, or 51 cents a share in the like period of last year. Total sales for the nine months were $39,303,760, compared with $35,997,797.

•

Sales Training Program

A national sales training program for Launderall distributors, dealers and their salesmen has been announced by the F. L. Jacobs Co, Detroit. Edward A. Ash, director of the appliance division, said that while the program is built around Launderall "it was designed as an educational or refresher course for all major appliance salesmen." The program was prepared by TradeWays Incorporated of New York, based on a national survey and material obtained firsthand from outstanding distributor and dealer Launderall salesmen in all parts of the country.

Here's the answer!

to your everyday wiring problems

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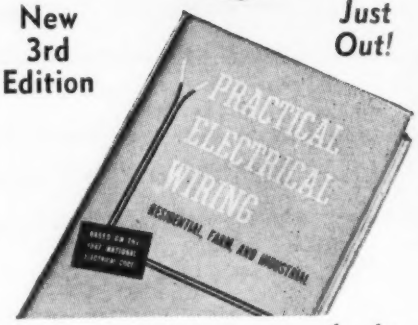
Just Out!



Shows you how to handle the medium-voltage wiring jobs most in demand today

Practical Electrical Wiring

Residential, Farm and Industrial

Based on the 1947 National Electrical Code

by H. P. RICHTER

Member, International Association of Electrical Inspectors

574 pages, 466 illustrations, $3.75

A COMPLETE course of instruction for those who want to learn more about electrical wiring. Designed for on-the-job guidance, this manual shows you how to do hundreds of medium-voltage wiring jobs in accordance with code requirements. It contains a minimum of mathematics—a maximum of tested, easy-to-follow methods and procedures—it shows not only *what* to do, but explains clearly *why* a job should be done in the manner shown.

See this valuable handbook for:

—easy-to-read chapters explaining basic electric principles
—descriptions of bulbs, sockets, outlets, switches, fuses, fixtures, wires, conduits, cables, boxes, connectors, switchboards, etc.
—instructions on handling and installing these devices
—simple analysis of lighting requirements
—step-by-step description of basic wiring methods
—practical interpretation of the code requirements for wiring for motors
—specific pointers on wiring homes, farm buildings, small factories, offices, stores, theatres, etc.

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Send me Richter's PRACTICAL ELECTRICAL WIRING for 10 days' examination on approval. In 10 days I will send $3.75, plus few cents postage, or return book postpaid. (We pay postage on cash orders.)

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CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Colorado — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo, furnishing, del. f.o.b. cars shipping point or f.o.b. cars Loveland, 12 indoor current transformers for line side of generators; 12 for neutral side of generators; for Estes and Marys Lake Power Plants, Colorado-Big Thompson Proj. Spec. 2012. W. R. Young, ch. engr.

Georgia — Okofenoke Rural Electric Membership Corp., Nahunta, sys. imprvs. and 283 mi. rural distr. lines, Brantley Co. **$440,000.**

Illinois—Shelby Electric Co-operative, Shelbyville, addnl. rural distr. lines, Shelby Co. **$525,000.**

Missouri — Osage Valley Electric Co-operative Assn. c/o Manager, Butler, Mo., rural distr. lines in Bates Co. and vicinity, imprv. and connections existing sys. **$620,000.** Frank Horton & Co., Lamar, engrs.

Nebraska—Howard-Greeley Rural Public Power Dist., St. Paul, sys. imprvs. and 201 mi. rural distr. lines, Howard Co. **$436,000.**

Okla., Durant—U. S. Eng., 416 Wright Bldg., Tulsa, power house, air-conditioning and installing equip. in offices. **$90,000.**

South Dakota—U. S. Eng., 1709 Jackson St., Omaha 2, Neb., power line for radio station at Pickstown near Lake Andes, Serial No. W-25-066 eng-48-200.

Tennessee—U. S. Eng., P. O. Box 1070, Nashville, furnishing, del. f.o.b. cars Lancaster, two 62,500 hp. hydraulic turbines and 2 governors, accessories, Serial No. W-40-058-eng-48-37.

Wisconsin—Northern States Power Co., 2 S. Barstow St., Eau Claire, dam site 600 ft. concrete spillway and 4,200 ft. earth embankments, power house, substation, 15 mi. transmission line, near Holcombe.

O., Ashtabula—Electro Metallurgical Co., Ashtabula, power plant, separate contracts. Over **$1,000,000.** Ford Bacon & Davis, 39 Broadway, New York, N. Y., engrs.

Low Bidders & Contracts Awarded

Georgia—Walton Co. Electric Membership Corp., Monroe, Nov. 5, 234 mi. rural distr. lines, Walton, Barrow, DeKalb, Rockdale, Oconee, Morgan, Greene and Clarke Counties, from Roy Richards Constr. Co., Carrollton. **$234,526.**

Ill., Chicago—City of Chicago, Subways & Superhighways, 20 N. Wacker Dr., Nov. 6, Dearborn St. Subway, Contr. T-13A, circuit breakers, dis-connecting switches, panels and other equip., from T. E. Circuit Breaker Co., 35 N. Michigan St., **$59,790*****Contr. T-13B, supervisory control equip., from Westinghouse Electric Corp., 20 N. Wacker Dr., **$87,236*****Contr. T-13C, emergency alarm sys., etc., from The Gamewell Co., 201 N. Wells St., **$34,965.**

Missouri—Farmers Electric Co-operative, E. C. Wood, mgr., Chillicothe, 234 mi. rural distr. lines, Livingston, Linn, Chariton, Carroll, Ray, DeKalb, Caldwell, Clinton and Daviess Counties, own forces. **$280,000.** Frank Horton & Co., Lamar, engrs.

Texas—Rita Blanca Electric Co-operative, 611 Tennessee Blvd., Dalhart, 228 mi. rural distr. lines, Dallan Co., to Sisco Electric Co., Conroe, labor **$61,955,** materials **$228,000,** total $289,955. Hollis W. Harris, Johnson Bldg., Amarillo, engr.

Virginia—Virginia Electric Co-operative, Bowling Green, 205 mi. rural distr. lines, Carolina Co., to Dewey G. Weddle & Co., 1001 Natl. Bank of Commerce Bldg., Norfolk, labor **$36,750,** material

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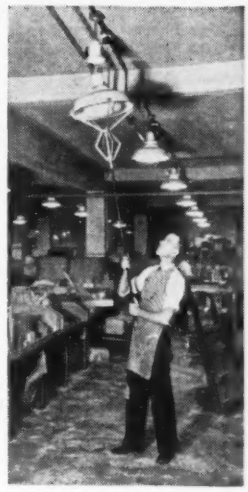

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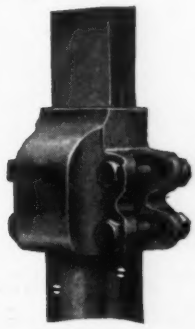

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$205,000, total $241,750.

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Proposed Construction

Colo., Denver—Denver Y.M.C.A., 1600 Lincoln St., modernizing present building, E. 16 Ave. and Lincoln Sts., addn. on Lincoln St., exten. to Shirley-Savoy Hotel. **$1,000,000.**

Del., Wilmington—Alfred I. du Pont Institute, Rockland Rd., children's hospital addn. **$1,200,000.**

Kan., Kansas City — International Brotherhood of Boilermakers, Inc., Shipbuilders & Helpers of America, Botherhood Bldg., Kansas City, Kan., business bldg. and offices. **$2,000,000.** Maultsby & Co., 745 Minnesota St., Kansas City, Kan., archts.

Md., Annapolis—State, Bd. P. Wks., John B. Funk, ch. engr., 210 E. Lexington St., Baltimore, 3 story, brick, stone, steel Legislative Office. **$2,000,000.**

N. J., Trenton—Mercer County Medical Society, 120 W. State St., tuberculosis bldg. **$2,000,000.**

N. Y., St. Albans—Yards & Docks Annex. Navy Dpt., Arlington, Va., plans by York & Sawyer, 101 Park Ave., New York, Zone 17, converting U. S. Naval Hospital at Linden Blvd. into permanent service center for cancer treatment, 10 three story ward bldgs., 7 story central administration bldg., treatment and clinic bldg., 2 story subsistence bldg. **$15,000,000.**

Okla., Oklahoma City—Medical Research Foundation, Medical Arts Bldg., plans by Sorey, Hill & Sorey, 1st Natl. Bldg., Oklahoma City, medical research bldg. **$600,000.**

Tex., Houston—University of Houston, Commerce Bldg., 3 story, bsmnt., 88x424 ft., 123x269 ft. administration and auditorium, and 4th and 5th floors 66x133 ft., limestone, masonry constr. **$1,225,000.** A. C. Finn, archt. and Robert J. Cummins, engr., both Bankers Mortgage Bldg.

Wash., Seattle—Nettleton, Baldwin, Anderson, Inc., 1109 N. 36 St., Zone 3, plans by E. W. Morrison, 719 2 Ave., Bldg., Zone 4, 14 story apartment. **$3,000,000.**

Wis., Whitefish Bay—School Dist. 1, 1200 E. Fairmount Ave., Zone 11, plans by Wm. G. Herbst & Assoc., 1249 N. Franklin Pl., Milwaukee, Zone 2, 2 story, bsmnt., 110x191 ft. wing 62x92 ft., steel, concrete, brick, stone memorial bldg. **$987,000.**

Low Bidders & Contracts Awarded

Calif., Pasadena—Huntsinger Estates, Pasadena, 2 story, bsmnt., 200x200 ft., brick, steel professional bldg., to McNeil Constr. Co., 5860 Avalon Blvd., Los Angeles. Over **$500,000.** Wm. D. Coffey, 649 S. Olive St., Los Angeles, engr.

Conn., Danbury—Sperry Products, Inc., J. B. Farwell, pres., Hoboken, N. J., brick, steel factory, on 20 acre site, Shelter Rock Rd. and N.Y., N.H. and H.R.R., to Bernard J. Dolan, 207 Greenwood Ave., Bethel. Est. **$1,000,000.** Fletcher Thompson, Inc., 211 State St., Bridgeport, archt.

Ind., Indianapolis—H. P. Wasson Co., Meridian and Washington Sts., 8 story, bsmnt., sub-bsmnt., 83 x 120 ft., limestone, granite, steel department store addn., to W. P. Jungclaus Co., 825 Massachusetts Ave. Est. **$1,000,000.** Awarded 11/5. Graham, Anderson, Probst & White, Railway Exchange Bldg., Chicago, Ill., archts.

Ky., Frankfort—Kentucky Unemployment Compensation Comn., Oct. 23, office bldg., from F. W. Owens Co., 119 N. 5 St., Louisville. **$1,048,000.**

La., Shreveport—Caddo Parish School Bd., 501 Courthouse, Junior High School, Ockley Dr., to Southern Builders, Inc., Hunter Bldg. **$795,937.** Awarded 11/6.

N. Y., Buffalo—Veterans Admin., Constr. Div., Branch Office 2, 346 Broadway, New York, Zone 13, general construction work in Burrell Bldg., to Siegfried Constr. Co., 6 N. Pearl St. **$709,149.**

Pa., Morrisville — Victor Chemical Works, 141 W. Jackson Blvd., Chicago, Ill., 2 story, 100x100 ft. brick, steel processing plant, to Wininger & Shelby, Inc., 10 Rockefeller Plaza, New York, N. Y. **$1,500,000.**

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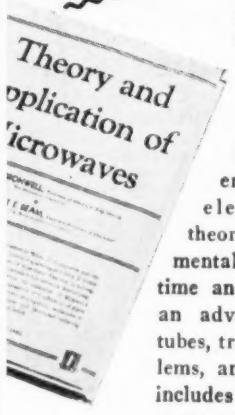

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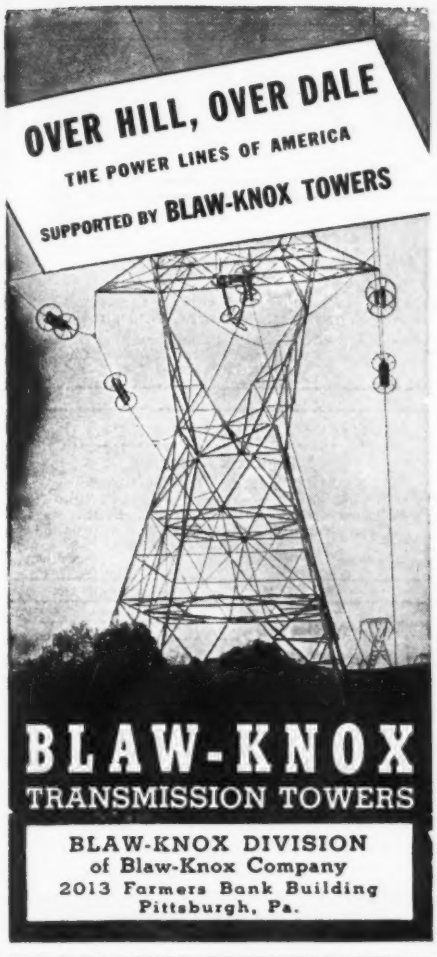

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LETTER TO THE EDITOR

About the Marshall Plan

To The Editor of ELECTRICAL WORLD:

In your issue of October 11, your article on the Marshall Plan gave figures for productive capacity, of certain European countries, of electrical equipment. These figures appear to be much lower than actual capacity except as concerns Germany, which is not actually in a position to deliver one million kilowatts of equipment per year.

France's productive capacity was studied in connection with the Monnet Plan. Capacity was estimated at 650,000 kw for thermal plants and 1,100,000 kw for hydro units, or a total of 1,750,000 kw, rather than 400,000 as stated.

This assumes procurement of a small number of machine tools and, above all, a regular flow of raw material, which lack of coal and of electric current could compromise. On the other hand, the achievement of this production is facilitated by the fact that for steam turbines the types have been strictly standardized to three sizes—i.e., 25,000, 50,000 and 100,000 kw. Hydro installations include a large part of turbines for high heads—the production of which is easier and for which, also, a certain amount of standardization has been obtained. The Monnet Plan includes, for example, a certain number of installations of 50,000 kw (one alternator with two Pelton-type wheels), such as have already been used in an existing plant of high head.

In summary, an annual average production of 1,500,000 kw could be reached by France during the next five years.

Yours very truly,
P. LeBourhis
Chairman & Managing Director
S.G. de C.E.M. Als-Thom

(Ed. Note: Our discussion of Mr LeBourhis' position will be found on page 70.)

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Franchise Approved

Voters of Brunswick, Ga, have voted 1,292 to 417 in approval of an indeterminate franchise granted by the City Commission to the Georgia Power Co. The utility will pay 3 percent of its gross residential and commercial revenue as a franchise tax. The old franchise still had nine years to run, but the utility asked for the new type franchise.

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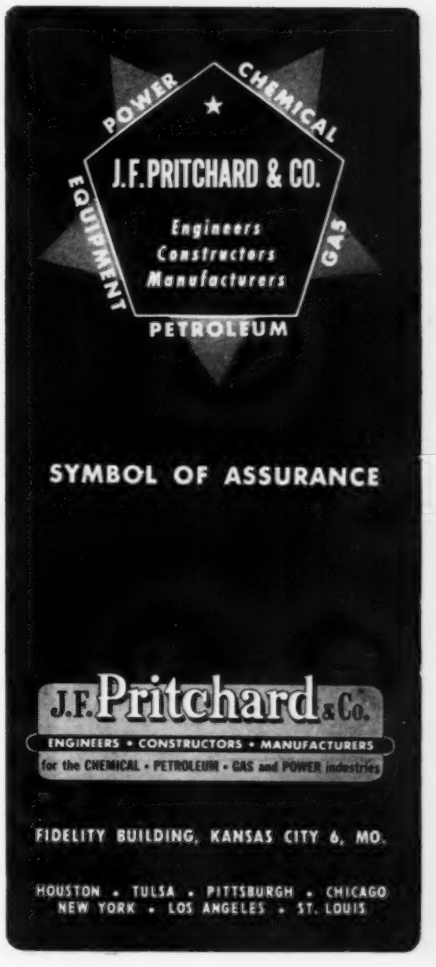

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